HIS EXCELLENCY SIR HENRY A. BLAKE, G.C.M.G.

Peradeniya Manuals of Botany, [illegible]
and Horticulture.

No. 1.

RUBBER IN THE EAST:

BEING THE OFFICIAL ACCOUNT OF THE CEYLON RUBBER EXHIBITION HELD IN THE ROYAL BOTANIC GARDENS, PERADENIYA, IN SEPTEMBER, 1906.

EDITED BY

J. C. WILLIS, Sc.D., F.L.S.,
Director, Royal Botanic Gardens, Peradeniya.

M. KELWAY BAMBER, F.I.C., F.C.S., M.R.A.C., M.R.A.S., Eng.,
Government Chemist.

E. B. DENHAM, C.C.S.,
Secretary, Rubber Exhibition Committee.

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PREFACE.

THE first Rubber Exhibition ever held was opened on September 13, 1906, at Peradeniya. The duration of the Exhibition allowed of its being a Rubber Congress, lectures being given upon the various branches of the subject, from cultivation to vulcanisation. These lectures, with the discussions following them, proved to be one of the most valuable and most appreciated features of the Exhibition. In the following pages these lectures and discussions are given in a fully revised form. All lectures have been fully revised by lecturers and have then been arranged in a logical order with the hope of making this account a standard treatise upon the Rubber industry as it at present exists. In the same way, the lists of entries, the prize winners, the reports of the Judges, reports of the Visitors, and other matter have been incorporated each in its proper sequence, so that almost the whole subject is covered.

We are much indebted to the givers of the lectures for kindly revising their remarks; to Mr. A. N. GALBRAITH, C.C.S., for the account of the Exhibit of the Ceylon Agricultural Society; to Dr. A. K. COOMARASWAMY, for the description of the Arts and Crafts; to Mr. T. J. CAMPBELL, Conservator of Forests, for his chapter on the Ceylon Woods Exhibit.

We desire to take the opportunity of expressing our gratitude and that of all those who are so deeply interested in this important industry, to Sir HENRY A. BLAKE, G.C.M.G., Governor of Ceylon, who by his active interest and encouragement made the Exhibition possible and rendered it successful.

JOHN C. WILLIS.
M. KELWAY BAMBER.
E. B. DENHAM.

Prefatory Note with regard to the "Peradeniya Manuals."

THE publication of this volume represents the first step towards the carrying out of a scheme which has been in view for some years, but was interrupted by my serious accident of last year, viz., the formation of a standard series of Manuals of Tropical Botany, Entomology, Agriculture, and Horticulture, written by the staff of the Peradeniya institution and other writers, and published at intervals. Should the present volume meet with success, it will probably be followed by others dealing with the Up-country Flora of Ceylon, with the commoner Insect and Fungus Pests and how to deal with them, with Camphor, with Gardening in Ceylon, and many other topics.

JOHN C. WILLIS.

The Ceylon Rubber Exhibition.

President:

His Excellency the Governor, Sir Henry A. Blake, G.C.M.G.

Committee:

The Hon. Mr. J. P. Lewis, M.A., C.C.S., Government Agent, Central Province, *Chairman*.
The Hon. Mr. E. Rosling, M.L.C.
Mr. T. C. Huxley.
Mr. Edgar Turner.
Mr. James Ryan.
Dr. J. C. Willis, F.L.S., Director, Royal Botanic Gardens.
Mr. M. Kelway Bamber, F.I.C., F.C.S., M.R.A.C., M.R.A.S., Eng., Government Chemist.
Mr. Herbert Wright, A.R.C.S., F.L.S., Controller, Experiment Station, Peradeniya.
Mr. A. N. Galbraith, C.C.S., Secretary, Ceylon Agricultural Society.
Mr. W. Dunuwille.
Mr. H. F. Tomalin, Provincial Engineer, Central Province.
Mr. E. B. Denham, C.C.S., *Secretary*.

Judges:

Rubber:

Mr. Spencer Brett, Messrs. Gow, Wilson & Stanton, London.
Mr. C. G. Devitt, Messrs. Lewis & Peat, London.
Mr. C. K. Smithett, Messrs. Wilson, Smithett & Co

Machinery, Tapping Knives, &c.:

Mr. G. H. M. Hyde.
Dr. J. C. Willis, F.L.S.
Mr. J. B. Carruthers.
Dr. Cuthbert Christy.
Mr. M. Kelway Bamber.
Mr. W. Boak, M.I. mar. E., M.I. mech. E.

Photographs:

Mr. W. D. Bosanquet.
Mr. J. H. de Saram, C.M.G.

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CHAPTER I.

THE CEYLON RUBBER EXHIBITION.

THE idea of holding a Rubber Exhibition appears to have originated with Mr. James Ryan, an up-country planter. It was also discussed at Peradeniya. In January last the late Mr. Wace, C.M.G., then Government Agent of the Central Province, and Dr. J. C. Willis, Director of the Royal Botanic Gardens, Peradeniya, were asked by His Excellency the Governor to make arrangements for the Exhibition.

A Committee was appointed consisting of the Hon. Mr. Rosling (Planting Member of Council), Mr. Edgar Turner (Secretary of the Planters' Association), Mr. T. C. Huxley, Mr. James Ryan, Mr. Kelway Bamber (Government Analytical Chemist), Mr. Herbert Wright (Controller, Experiment Station, Peradeniya), in addition to Mr. Wace and Dr. Willis.

Mr. Wace was appointed Chairman and Mr. E. B. Denham, of the Civil Service, Secretary. The Committee had to deplore the death of the Chairman, Mr. Herbert Wace, C.M.G., on 28th May last. Mr. J. P. Lewis, who succeeded him as Government Agent, Central Province, became Chairman of the Committee.

Mr. A. N. Galbraith, C.C.S., Secretary of the Ceylon Agricultural Society, Mr. William Dunuwille, and Mr. H. F. Tomalin, Provincial Engineer, Central Province, were subsequently added to the Committee.

It was decided to hold the Exhibition at Peradeniya in September to allow sufficient time to inform those interested in rubber in England and on the Continent and to obtain exhibits and information from America and other parts of the world whence rubber is exported. It was further stated to be the best time in the year for the flow of latex in Ceylon.

It was originally intended to hold the Exhibition for three days. This was subsequently extended to a fortnight, as it was thought that exhibitors of machinery would not be prepared to send valuable exhibits considerable distances for such a short period of Exhibition.

The extension of time also allowed of a considerable programme of lectures being arranged.

The first step taken was to circularise the leading manufacturers of the world.

A circular was drawn up by Dr. Willis (*vide* Appendix A) and sent out to 124 manufacturers at the end of February.

The Planters' Associations in Ceylon, the Straits, and India, and the foreign Consuls in Ceylon and in South America, West Africa, and other parts of the world were also addressed.

A leaflet was issued giving an account of the Rubber Industry in Ceylon and further particulars of the regulations and scope of the Exhibition for wide circulation; it was sent to Messrs. Cook & Sons, Reuter's Agency, &c., and the Agents of the different Steamer Services to Ceylon to be placed on board their steamers.

Government sanctioned the grant of free transport on the Government Railway for exhibits and exemption from Customs duty on machinery imported.

It was decided to provide power and pulleys for all machinery exhibited.

The List of Prizes offered was drawn up by Dr. Willis and Mr. Herbert Wright and copies were circulated.

It was made a special object of the Prize List to award prizes for new instruments or contrivances which would tend to solve the principal problems before the rubber planter, *e.g.*, those of tapping, storing, and preserving liquid latex, determining the amount of acid required for coagulating latex, and the best method of coagulating it to marketable rubber, for preventing putrefaction, for drying, testing, and packing rubber.

Gold medals were to be given for the best machine for uprooting, and the best method for destroying, stumps of trees —difficulties the planter continually encounters.

In all 43 gold medals and 22 silver medals were offered, in addition to three silver cups of the value of £10 each to the Superintendent of the estate exhibiting the best sample of Para, Ceara, and Castilloa, and a silver bowl of the value of £15 15*s*. to the Superintendent of the estate exhibiting the best commercial sample of rubber in the Show (open to all exhibitors).

Prizes to the value in all of Rs. 817 were given by the Planters' Association, the Chamber of Commerce, the Kandy, Kalutara, Dikoya, and Ambagamuwa Planters' Associations.

Two special prizes of a Gold Medal were further awarded for the best samples of rubber from the Malay Peninsula and India.

A leaflet was distributed widely giving further particulars of the awards and explaining what was required of competitors.

It was felt that Judges should, if possible, be obtained from England. A number of circular letters were sent to the Director of the Imperial Institute, who was requested to issue them to the best known Rubber Brokers in London. The circulars were addressed to each firm to ascertain if they proposed to send out any representative to the Exhibition, and if so whether it would be made conditional on the Rubber Exhibition Committee paying part travelling expenses, the representative of the firm to assist in judging at the Exhibition.

Messrs. Gow, Wilson, & Stanton, Wilson & Smithett, and Lewis & Peat, three firms dealing largely in rubber, sent out representatives, who acted as Judges, and each received £50 as part travelling expenses in return for their services as Judges.*

The Agricultural Departments in all parts of the world were further addressed through the Secretary of State for the Colonies, the Imperial Institute, and direct. Replies were received from Seychelles and Mexico, amongst others stating their desire to be represented at the Exhibition or to send exhibits. The following delegates or representatives were present at the Exhibition :—

Mr. J. B. Carruthers, Director of Agriculture. Federated Malay States, who represented the Straits Settlements as well as the Federated Malay States.

Mr. H. C. E. Zacharias, Secretary of the United Planters' Association, Federated Malay States, and Messrs. P. W. Parkinson and F. G. Harvey, who represented the planting interests of Malaya.

India sent Dr. Lehmann, Analytical Chemist, Department of Agriculture, Mysore;

Mr. J. Cameron, Curator, Botanic Gardens, Bangalore;

Mr. R. L. Proudlock, Curator, Botanic Gardens, Ootacamund; and

Mr. G. H. Krumbiegel, Curator, Botanic Gardens, Baroda.

The South Indian Planters' Association was represented by Mr. W. H. Sprott.

The Philippines by Mr. W. L. Hutchinson. Forester of the Bureau of Forestry.

Burmah by Mr. Coventry of the Forest Department.

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* Their report appears on pages 187 to 189.

There were exhibits from Germany, South India, Belgaum in the Bombay Presidency, the Philippines, as well as an interesting collection of the rubbers of the world sent from London by Messrs. Figgis & Co., in addition to the large collection of exhibits from Malaya.

The Committee were considerably handicapped by the difficulty of estimating the space the exhibits were likely to require and what machinery would be exhibited. It was doubtful whether Ceylon entries would be confined to a few large companies, or whether the smaller estates would also compete; whether exhibits would be sent from Malaya, and what machinery would be shown.

In fact, as is usually the case in all local exhibitions, entries were sent in up to the very last moment. The smaller estates competed with very few exceptions, and the collection was representative of the principal rubber estates in Ceylon as well as those only partly planted with rubber. The gold medal for the best Para Rubber Biscuit in the Exhibition was won by an estate of which only a comparatively small area is planted in rubber.

Nearly all the exhibits of rubber shown at the Singapore Agri-Horticultural Show in August were sent on to Ceylon with other additional exhibits. These exhibits took up the centre of one of the wings of the buildings.

As perhaps might have been expected, there were no entries of machinery by English or Continental firms, who were no doubt deterred by the distance, the fact that it was the first Rubber Exhibition ever held, and that the time allowed them for consideration was necessarily short.

Further, as was stated by one of the Judges (Mr. S. Brett) in his paper on "Rubber in London," "it is a difficult matter to obtain an inside knowledge of the nature of the Rubber Manufacturers' business. A great number of them, whose successful career has in some measure been due to the efficiency of their private processes and methods of preparation, are naturally somewhat jealous of these, and disinclined to expose them to the critical eye of any one engaged in the same industry."

Two machines from Malaya were exhibited. The rest of the machinery exhibits were shown by Ceylon firms.

The scope of the Exhibition was considerably extended by the inclusion of exhibits of other products, catch crops, &c., shown by Branches and Members of the Ceylon Agricultural Society.

The Arts and Crafts section occupied a separate pavilion and several tents. The object of the Exhibition was to show the different craftsmen at work. Silversmiths, brass workers,

lace makers, weavers, dyers, ivory workers, painters in wood and on earthenware, brass founders, iron smelters, basket makers, potters—were all represented. Working parties came to the Exhibition from Batticaloa, Mannar, Jaffna, Kalutara, and the low country as well as the numerous workers in brass and silver and the weavers of the Kandyan District.

A handbook compiled by Dr. A. K. Coomaraswamy (which is reproduced in this volume) gives particulars of the different arts and crafts exhibited.

Specimens of exhibited work were for sale. Exhibits of ancient silver and brass work, carving, mats, cloths, &c., were lent by their owners, and filled the interior of the large pavilion set apart for this side show. Some of these exhibits were of considerable value, and had never been exhibited publicly before ; amongst these special mention may be made of a beautifully carved ivory model of the Dalada Maligawa, which is said to have been presented by King Kirti Sri Rajasinha in 1755 to the Hittalia Temple, Matara.

A collection of old china was another interesting exhibit, the specimens ranging from the blue V. O. C. Dutch plate to the Sannasi's begging bowl, from the Dutch snuff-box with its picture of Amsterdam to the betel-box of the Sinhalese villager.

Another interesting exhibit was one of the woods of Ceylon, shown by the Forest Department.

Facilities were offered to any firm to exhibit goods for sale in the grounds on their erecting a pavilion approved by the Secretary. Artistic buildings were put up by Messrs. H. Don Carolis & Sons, Sinhalese furniture dealers, and a firm of jewellers. There were also special exhibits of manures and of articles made of Ceylon rubber by Messrs. Freudenberg & Co., of agricultural implements by Messrs. Brown & Co., of Chemicals by Messrs. Cargills Ltd., of Thorianite by Messrs. Finlay, Muir & Co., of Motor Tyres by Messrs. G. C. S. Hodgson and R. Davidson and Messrs. Walker, Sons & Co., of Rubber Stamps by Messrs. P. P. Rele & Co. of Bombay, of Cotton and Cotton Ginning by Messrs. J. Whitehead, of Camphor distillation by Mr. Kelway Bamber, and of Photographs by Messrs. Plâté and Cave and the Colombo Apothecaries Company.

A hut constructed of a specially patented material, a combination of veneer and paper, was erected by Mr. J. Coryton Roberts.

The full list of entries is given under the different chapters dealing with these branches of the industry.

While there was thus no lack of exhibits of all kinds, in many ways the most remarkable exhibit at the Exhibition were the Exhibition buildings.

The work of erecting these buildings was entrusted by His Excellency the Governor to Mr. William Dunuwille, Police Magistrate of Matale. Mr. Dunuwille, who was assisted by Mr. P. B. Nugawela, Ratemahatmaya, constructed a building on the lines of a bana maduwa. It was entirely a Kandyan work, constructed throughout by Kandyans in Kandyan designs, painted and adorned in Kandyan colours.

The building was a hexagon, from which three bays ran out; at the entrance was erected an elaborate portico. The prevailing colours were red, yellow, white, and blue; in these colours the pillars and ceilings were all painted. The pillars bore pictures of kings and queens, priests and chiefs, representations of the sun and moon and celestial bodies, figures of sacred animals and birds, with elaborate scroll patterns of flowers and fernery. The ceiling cloths were even more elaborate, each representing a scene in history, chapters in the lives of Buddha or of heroes, symbolical signs or figures. Round the pillars were ornamental spans made of vari-coloured rosettes, called by the Kandyans "reli palam," successfully designed to give the effect of rainbows. The whole building was sorrounded by a half-wall of Kandyan design, crenelated and vandyked with an ornamental border called a "wala-avoul-bana."

The effects of light and colour are difficult to describe. The excellent photographs taken of the interior give a very inadequate idea of the general appearance of the buildings, for the remarkably harmonious colours are not reproduced.

Workmen from all the neighbouring villages were employed on these buildings, and elephants were used in dragging the materials on to the ground.

The rapidity with which the buildings were erected was remarkable; they were completed in twenty-seven days.

The successful management of the labour force, the number who worked without intermission, and the alacrity with which they worked were largely due to the fact that in the erection of the Exhibition buildings the Kandyans were engaged on a task to which previous ages had accustomed them; they were building a royal house in royal and ancient Kandyan patterns. It was work which could be apportioned to castes: the painter caste found work required of them which they knew and understood, work for which they had no need of new models or designs. They were painting what heredity had taught them, the pictures that their ancestors had painted before them, and with which they had from time immemorial decorated their wedding-houses and pandals; the carpenters, the masons, the dhobies, all found employment as they would have found it hundreds of years before; they were all called

out to assist in the construction of a work which to them had a peculiarly Kandyan and historical significance. Nothing was omitted which was consecrated by past observance. The building was commenced at an hour and date fixed after careful deliberations by a famed astrologer. Two astrologers were present throughout the work. The success of their intervention was abundantly justified to the workmen by the fact that there was no accident and no sickness. There were the moonstone (the handagala) on the top of the step to the dais, the open lotus flower (diya nilum mala) was hung above the seat reserved for the Governor, the handles of the door came from a Buddhist temple, the arch at the entrance bore two "makara torana," representatives of griffins as supporters as a heraldic device. The gates bore representations of lions with the tusks of elephants (the Jaya Sinha of the Sinhalese).

The pillars were painted with Kandyan paint—save when time outran tradition, when signs of a popular English blue paint could be detected—and varnished with jak fruit juice.

The conservatism of the Kandyan was thus in touch with a work which expressed their national art and religion in the form consecrated for them by ages; it was an opportunity to show their children the arts of their parents and to preserve those arts.

To the charm of association in a work conducted with the ritual and ceremonies of the past was added a modern and novel attraction, one which reminded the workmen of the age they lived in while their work was a reminder of the past. The workmen were not obliged to make a settlement for themselves near their work, build rough dwellings, find their own provisions as they would have done in the ages in which they built such palaces at their kings' bidding.

They came from districts within easy distance by rail of Peradeniya.

Trains brought them to their work and took them back at night.

Railway passes were issued daily for the number of workmen.

These journeys, besides the advantage that they allowed the workmen to sleep at their homes, were greatly appreciated.

Railway travelling is a popular amusement in the East: two journeys a day on free passes when nearly all their neighbours were sharing in the excursion was a treat which made each day seem a holiday.

The buildings at the Rubber Exhibition will serve for many years as a model of Sinhalese decorative art as the design to be followed for "Ceylon Courts" and all Exhibition buildings

of the future. They revived a lost art and form of decoration which was in danger of being forgotten.

The Exhibition was opened by His Excellency the Governor on the 13th September, in the presence of a large number of persons.

The Exhibition was open for fifteen days, and was well patronised throughout. Six thousand and ninety-five persons paid for admission, in addition to a large number of season ticket holders and exhibitors, who were given free passes.

The last day of the Exhibition (27th September) was "The Governor's Day." His Excellency invited all to attend the Exhibition without charge for admission. It was visited by very large crowds: tickets were issued at the gates to 12,000 people.

One of the features of the Exhibition was the series of lectures given by Members of the Botanic Staff, the Rubber Judges from England, and Delegates from the other countries.

The following lectures were delivered :—

- On Rubber and Cotton, and on the Lessons of the Exhibition, by Dr. J. C. Willis.
- On Rubber Cultivation, on Lemon Grass, and on Citronella, by Mr. Herbert Wright.
- On Vulcanization of Rubber, on Tobacco, and on Camphor, by Mr. Kelway Bamber.
- On Prevention of Diseases in Rubber Plants, by Messrs. E. E. Green and T. Petch.
- On Rubber in London, by Messrs. S. Brett and C. K. Smithett (two of the Judges).
- On Shipment of Rubber, by Mr. C. G. Devitt (a Judge).
- On Rubber in the Malay Peninsula, by Mr. J. B. Carruthers, Director of Agriculture, Federated Malay States.
- On Rubber in South India, by Mr. E. G. Windle.
- "The Use and Objects of Agricultural Societies," by Mr. E. B. Denham, C.C.S.

In addition to lectures, special demonstrations in tapping, &c., of rubber trees were given at Peradeniya and at Henaratgoda by Mr. Herbert Wright, Controller of the Experiment Station, Peradeniya.

The Director, Royal Botanic Gardens, and his staff were "At Home" to visitors between 9.30 and 11.30 A.M. daily.

The lectures and discussions which followed proved of considerable use to visitors to the Exhibition, and lent additional interest to each day at the Exhibition, which became a Rubber Congress.

The cost of the Exhibition cannot be accurately given at present as a number of bills have still to be received, including those for advertising the Exhibition abroad, which was done through Reuter's Agency. It is anticipated that the nett cost of the Exhibition will not exceed Rs. 50,000.

An Exhibition intended to advertise a new industry, to furnish information with regard to it, and to give scope for its further development, held for a period of fifteen days, cannot be judged by a balance sheet of receipts and payments.

It was the first Rubber Exhibition ever held. It was thought by many that it was premature, and that it could not be expected that the cultivation at the stage it had reached had sufficient to exhibit or could present enough features to interest. These critics overlooked the truth that the beginning of knowledge is to know that one is ignorant.

As the Exhibition continued and the lectures drew large audiences it became clear that every person interested in rubber had now the opportunity for the first time to see and discuss the methods he found his neighbour using, and in many cases to wonder why he had not thought of improving on them. To take two instances: the Ceylon Rubber Exhibition of 1906 has undoubtedly shown the unsuitability of the "biscuit" form for exporting rubber. Malaya won the prize for the best commercial sample of rubber in Exhibition with "block" rubber. It was clear to any one seeing the different forms of rubber shown together, the biscuit with the block and the sheet, that the biscuit was not the form for commercial purposes.

Again, the instruments for tapping and pricking rubber trees shown at the Exhibition will doubtless find a place in a Museum in five years' time as interesting examples of how ideas emerge from the crudest forms. But the lesson taught by the exhibits of knives and prickers was the necessity of simplicity in every form of machinery and the scope for ingenuity and common sense in devising suitable instruments.

Interesting experiments were suggested by the study of the different exhibits; as, for instance, in the preparation of rubber, whether rubber was washed too much; whether some of the other constituents present in the latex were not removed to the detriment of the quality of the rubber; whether the addition of a little creosote to the milk before coagulation would make the rubber better to handle; again, whether more favourable results might be obtained by taking the Ceylon biscuit damp and not drying it until it was transparent, taking it while still opaque, mixing with creosote to prevent any decay or growth of mould, bulking it damp, and pressing it into a block.

These experiments were suggested by the study of the different exhibits of rubber, by comparisons with the Malay rubber and with the specimens of the Para rubber of the Amazon shown at the Exhibition.

These and other experiments will now be carried out by the scientific staff at Peradeniya, but they will be brought within the knowledge and understanding of a far larger number of persons, who will watch for results and appreciate the chances of success.

The lecture in vulcanization and the exhibits of vulcanized rubber shown by Mr. Kelway Bamber opened up another large field of interest.

These are subjects of great value to all concerned with the rubber cultivation and industry; they interest the whole world of rubber and its market.

Locally, the Exhibition taught further useful lessons: one of the most important being that the area available for rubber was considerably larger than was generally supposed. The successful results in growing rubber under irrigation at the Government Experiment Station at Maha Iluppallama had prepared people to find that a large area, now untouched, was suitable for rubber cultivation. But the results of the Exhibition showed that rubber could be successfully grown higher "up-country" than had been supposed. The gold medal for the best Para rubber biscuit grown on an estate in Ceylon or abroad was won by Duckwari, an estate at an elevation of 2,600 to 3,000 feet. Several other up-country estates in the neighbourhood of Kandy, Matale, and higher elevations also won prizes.

If rubber can be successfully grown at these elevations, a much larger area is open for rubber cultivation in Ceylon.

A sample of rubber was shown by a native of the Matara District, another new field for this cultivation.

The Agricultural Society's exhibits supplied suggestions for the cultivation of catch crops with rubber in its early stages.

For those who were interested, not only in making the most of their old trees, and getting all they could from other sources during the years of waiting, the discussions on over-production, wide planting, prevention of pests and diseases, and manuring were useful.

The value of the side shows has been already referred to; while the Exhibition had its educational side for the rubber planter, there was much to make those think who could never hope to become the owners of rubber estates or who from the tradition of centuries would never willingly forsake the cultivations of their ancestors.

The Arts and Crafts of the Island were shown in their best forms—their oldest.

It is perhaps too much to hope that the artistic sense of the people of the Island may have been revived by the Exhibition at Peradeniya.

But the display of the ancient arts and crafts and of the beautiful work they are able to execute, the sight of buildings illustrative of Kandyan art and imagery, must have shown many that there were models in their own land worthy of imitation, and that they had no need to adopt those which, from the very fact that they are borrowed from scenes so different, can never be suited to the imagination of the East.

PAINTING THE CEILING CLOTHS.

CHAPTER II.

THE OPENING CEREMONY.

THE brilliant weather which favoured the scene before the opening ceremony became overcast as the hour approached and Their Excellencies made their entry into the Gardens amidst the depressing effects of a slight drizzle. Their Excellencies drove in State from the Pavilion to the Gardens with a large and imposing escort composed of forty members of the Ceylon Mounted Rifles, under the command of Lieut.-Colonel E. Gordon Reeves, Sergeant-Major Bidgood carrying the Colours, and were received by the Guard-of-Honour of the Ceylon Planters' Rifle Corps, which His Excellency inspected. Proceeding to the ornamental entrance of the gaily-decorated vestibule, His Excellency was presented with a golden key, resting on a silken cushion, the ring of which was formed of sovereign gold of a chaste Kandyan design. The shank of the key was of silver. With this key His Excellency unlocked an ancient Kandyan lock, the painted gates slipped back, and the distinguished party entered the vestibule and mounted the dais, where, surrounded by Members of the Executive and Legislative Councils, the Exhibition Committee, and other principal officials, the Governor was presented by the Hon. Mr. J. P. Lewis, Chairman of the Committee, on behalf of the Committee, with the following address :—

To His Excellency Sir HENRY ARTHUR BLAKE, Knight Grand Cross of the Most Distinguished Order of Saint Michael and Saint George, Governor and Commander-in-Chief, in and over the Island of Ceylon with the Dependencies thereof.

May it please Your Excellency,

WE, the Committee of the Ceylon Rubber Exhibition, welcome Your Excellency and Lady Blake to the Exhibition

inaugurated under your auspices, and request Your Excellency to be graciously pleased to declare it open.

The Exhibition owes its present magnitude and educational scope entirely to Your Excellency's initiation, friendly interest, and artistic sense. We trust that Your Excellency and Lady Blake may be long spared to see the rubber industry of Ceylon, the interest of which it is expected that this Exhibition will help to further increase and foster, so that it may, to some extent at least, justify the hopes which it now inspires of "a potentiality of growing rich beyond the dreams of avarice."

J. P. Lewis.
James Ryan.
Edgar Turner.
J. C. Willis.
M. Kelway Bamber.
W. Dunuwille.
Herbert Wright.
A. Norman Galbraith.
E. B. Denham, *Secretary.*

His Excellency had now taken his stand under an elaborate design suspended from the roof of the hexagon, consisting of a crown in gold on a red ground flanked on each side with the letters "E. R.," while below was suspended a representation of the Royal Coat-of-Arms. A beautifully carved ebony table and ebony stand turned out by the Kandy Industrial School, and a fine leopard skin with head were the special decorative features of this portion of the dais. Miss Lewis, the ten-year old daughter of Mr. and Mrs. J. P. Lewis, presented Her Excellency Lady Blake with a bouquet of flowers, the prevailing tints of which were red, yellow, and green, harmonising with the general scheme of colouring in the Exhibition building. The whole scene was resplendent and the spectacle magnificent. Nothing like it has ever been seen in Ceylon before, not even the scene presented in the Audience Hall at Kandy during the visit of the present Prince and Princess of Wales.

His Excellency's Speech.

His Excellency the Governor said :—Mr. Lewis, and Gentlemen of the Rubber Exhibition Committee ; The duty that you have called upon me to perform to-day is a very pleasant one, for I hope that the result of the Exhibition will be of great value to the rubber industry in which so large an amount of capital has been invested in Ceylon. Few industries have commended themselves so rapidly to the investing public.

Ten years ago, it may be said almost, that rubber trees were only known to a very few of them in Ceylon as shade trees for other products. Five years ago there was open in Ceylon about 2,500 acres, while up to the end of last year something over 104,000 acres have been opened, and the demand for land appears so far not to diminish. (Hear, hear.) It can hardly be expected that the present high price of rubber will continue when the great area that is now being opened here and in other countries has come into full production. But there is a very increasing use for rubber, and I have no doubt that the rubber industry will offer to investors in the future, having regard to the extension of its uses, as great a certainty of continuing demand as any other of the staple products of the Island. (Applause.)

We have invited friendly competition from other countries, and I wish now on your behalf and mine to express our acknowledgment to those countries who have responded, and especially our sister colony in the East, the Federated Malay States, and I think the Straits Settlements. (Applause.) In continuing I may say that our rubber exhibits appear rather small in comparison with these fine commercial exhibits sent in by the Straits, but that is owing to a mistake on the part of our planters in regard to the invitation issued to them by the Committee. They were informed by the Committee that the rubber specimens should be at least five pounds in weight, and I think the planting community accepted that as an intimation that the rubber exhibits were to be restricted to that weight. The judging, so far as I hear, is being done very carefully and very thoroughly by the gentlemen who have been good enough to come for that purpose from London, but has not yet been completed, and I can go no further than to say that I believe I am justified in saying that these gentlemen are not alone satisfied with the purity of the rubber that they have tested up to the present, but very well satisfied with its strength in comparison with that of the wild rubber standard, and that is a great point in the production of rubber for the market. (Applause.)

Now, what results are we to look for from this Exhibition? We expect to see, in the first place, authentic information imparted by the lectures that will be given here of the life-history of rubber-producing plants from the germination of the seed to maturity. We expect to know something more of the best conditions of soil and climate. We expect to know the most profitable system of tapping and of the treatment of latex when it has been extracted, and, lastly, the best method of preparation for the market. We have here the results so far that have been culled from the field, the

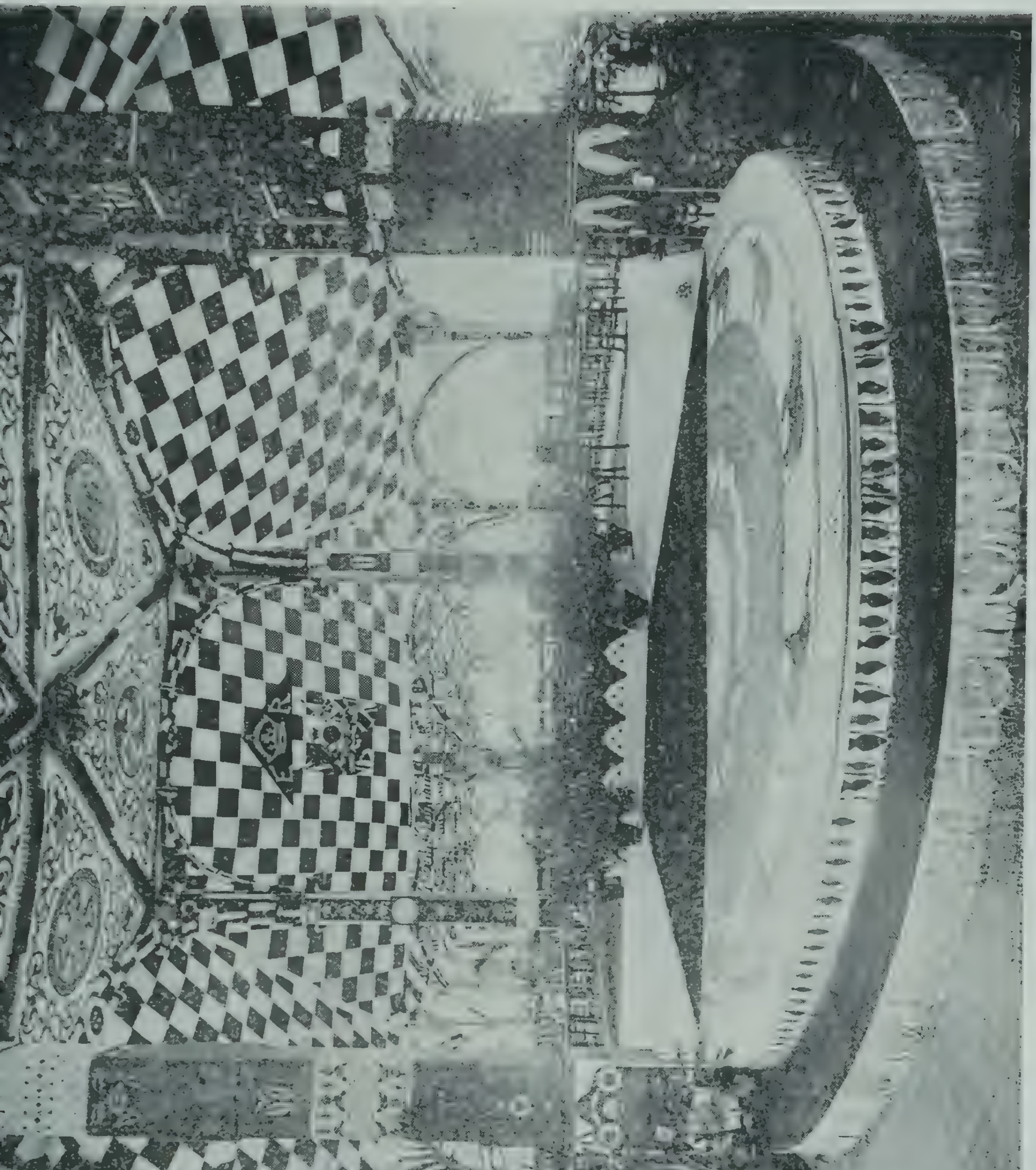
factory, and the laboratory, and the planter, chemist, and mechanical engineer have come forward to show us how much has been done up to the present moment and, if possible, to settle how this valuable product may be most economically grown and prepared for the markets of the world. It brings before us what is being done, and the discussions may intimate what remains still to be accomplished. Possibly tapping may find a rival in pruning and maceration, or possibly in the maceration of roots, stem, and branch of recurring crops of young trees, and all that is in the womb of the future, for I expect that the published result of the meetings that will be held in this Exhibition, of the lectures, discussions, and the demonstrations, will be the *vade mecum* of all rubber growers in the immediate future, while the enormous possibilities of Ceylon, with its hundreds and thousands of acres still possibly fit for rubber cultivation in addition to those that are open, with the great labour reservoir of the world at its very door, with its ever-increasing and excellent means of communication, and with its land free from all taxation, may be brought more prominently before the investing public at home and bring to Ceylon an increase of capital that will offer wages to thousands of labourers and extend still more the broad basis of prosperity on which the Island rests at present. (Applause.)

Now, gentlemen, having said so much about what we look to from the Rubber Exhibition, there is another aspect of this Exhibition to which I would claim your attention. First of all, I may say in mentioning this Rubber Exhibition that while the value of rubber may be very great, and is very great I think, that the most interesting and beautiful exhibit here to-day is the Rubber Exhibition itself. About six weeks ago the Committee woke to the fact that invitations had been issued for a certain date, but there was a disturbing fact that while the invitations were issued, no proper building had been erected for the reception of the exhibits that we might be led to expect, and in a happy moment of inspiration the Committee delegated to Mr. Dunuwille the task of raising a building – the main building—and to Mr. Ryan the task of providing and looking after the mechanical portion of the Exhibition. And how those gentlemen have done their work you see before you to-day. I now wish to offer my warm acknowledgments to Messrs. Ryan, Dunuwille, and Nugawela Ratemahatmaya, who, under the direction of Mr. Dunuwille, exercised a general supervision over the admirable work that they have accomplished. (Applause.) I think when I tell you that this building was constructed in twenty-seven days you will acknowledge that Mr. Dunuwille has every reason to be satisfied with his work. (Applause.) But when I go further

and tell you that this beautifully decorated building has been erected simply by the labour of the ordinary Kandyan villager, without the assistance of an architect, without the drawing of a plan, I think you will agree with me that those people are worthy of all praise. (Hear, hear.) Immediately the work was taken over, those villagers came together here in hundreds. They had no plans, the builders were here with their attendant patient and intelligent elephants, and the blacksmith with his tools, and the carpenter with his fret-saw, and the dhoby with his cloths for those decorations that you see so effective, and the painters producing in freehand those beautiful decorations and paintings that have come down from father to son through the tradition of the family through all the centuries, and all with their hands without an architect, without a foreman, without an overseer, each man working steadily with the full purpose and determination of doing the best he could. This building arose as if by magic, until in twenty-seven days it produced what you now see before you. (Applause.) I know no country in which by the work of the ordinary villager without professional assistance anything like this could have been accomplished, and I think it affords the most gratifying evidence of the artistic feeling of the Kandyan people. (Applause.) Now I hope also that the Exhibition in another building of some of the survived industries of Ceylon will have the effect of stimulating the revival of village industries that add so much to the comfort and the interest of a rural population. And now, gentlemen, I have great pleasure in formally declaring this Rubber Exhibition open, with the earnest prayer that the ultimate outcome of this Exhibition may be to the lasting benefit of this beautiful Island and its happy and industrious people. (Applause.)

The Governor and party were then conducted round the Exhibition and spent a considerable time inspecting the rubber exhibits, and returned to Kandy escorted by the Ceylon Mounted Rifles.

GATE OF ENTRANCE OF EXHIBITION.



LECTURES, DISCUSSIONS, JUDGES' REPORTS, DEMONSTRATIONS, &c.

IN the following pages the lectures, discussions, and demonstrations are given, with revisions and additions by the authors. In some cases they have been very considerably altered from those originally delivered. In order to make the work more generally useful, they have been arranged in as logical an order as possible, commencing with the cultivation and tapping of rubber, passing on to its preparation for market and shipment to Europe, and ending with its vulcanization. The Judges' Reports, Lists of Exhibits, and other features have also been introduced here to form a connected and consecutive whole.

CHAPTER III.

THE CULTIVATION OF RUBBER IN CEYLON AND OTHER COUNTRIES, TREATMENT OF DISEASE, &c.

As regards the actual cultivation of rubber, but little was brought into the series of lectures, for the planter now understands fairly well how actually to grow the rubber tree. One of the main bones of contention is how far apart to plant the rubber tree, and a side of this question which every one perhaps has not thought of is brought out in the lectures by Messrs. Green and Petch on Disease Prevention. Opinion in general seems to favour about 15 feet apart, or 15 by 20, as an *average* distance, it being understood that elevation, quality of soil, and other considerations will vary the actual distance for almost every case ; in some cases the trees may need to be only 10 by 10, in others 20 by 20. If the plants are put in 15 feet apart on the average, they will be able to grow undisturbed until about ten or twelve years old at any rate, and even older if they are heavily tapped. In other words, we shall not need to kill out some of the young trees by overtapping, a process which results, so far as we can at present see, in the obtaining of rubber of inferior quality. Of course, whatever distance apart, in moderation, the trees are planted, sooner or later they will need thinning, but it would seem better that this should not come, if avoidable, before ten or twelve years.

Demonstration at Henaratgoda.

By Mr. Herbert Wright.

A demonstration in connection with the Rubber Exhibition was given by Mr. Herbert Wright at Henaratgoda, where the first Para rubber trees brought to Ceylon are to be seen growing. The visit was made of special interest by the fact that during the last twelve months important tapping experiments have been in progress in the gardens from which the latest and most reliable data with regard to the yield of trees at different ages, and under different conditions of tapping, are obtainable. Some of the information had already been published, but a good many interesting details remained to be made known. A good number of the officials of the Exhibition, the judges, and others journeyed down by the morning train from Kandy and Peradeniya, arriving about eleven o'clock, and a few others had assembled at Henaratgoda.

On arriving at the Gardens, the visitors were conducted to the Laboratory, where Mr. Herbert Wright delivered a brief lecture. He said :—

Ladies and Gentlemen : You have been invited to Henaratgoda in order to see the parent Para rubber trees in Ceylon, and to observe the general characteristics of a small but somewhat typical Para rubber forest. As you are aware, the plants were sent from Kew in August, 1876, and since that time seeds and plants have been sent in thousands to almost every part of the tropics where rubber plants are likely to grow. I know there exists a friendly controversial spirit between officials in the Straits, and perhaps now in the Federated Malay States, and Ceylon, as to the origin of the Para rubber plants in the Malay Archipelago, but we are certain of one thing, and that is that plants were sent to the Straits from Ceylon in 1877, though their ultimate fate is somewhat obscure. The climate at Henaratgoda is a little warmer and more moist than that at Peradeniya, and the results obtained up to date lead one to suggest that it is, perhaps, more suitable for the growth of *Hevea brasiliensis*.

Before going through our series of experiments, I may, perhaps, be permitted to make a statement which is warranted from our past experiences. Visitors to Henaratgoda and to the Experiment Station must clearly understand that up to date results are given only to add to the sum total of our knowledge on the various points investigated, and not as results to be expected in the future or on the average estate.

The results obtained and published in Ceylon should be compared carefully with those obtained elsewhere, and, if other countries will only respond as freely as Ceylon, the Federated Malay States, the Straits, and India, in giving records of work done, knowledge of the highest importance to the rubber industry will soon be in our possession. The results tabulated for your information to-day are of interest, since they show what has been obtained by experiments on every section of the tree, from the base to a height of nearly fifty feet. They are at the best only fragmentary, and must not be accepted as the standard by means of which probable future yields can be calculated and checked. People are only too apt to regard a single year's results as something which will serve as a guide for, and stand the test of, the future; but I am sure that if the friends who visit these places were only in charge of scientific experiments for a few years, they would realise that the main point of interest in all such work is the variability of the results obtained. In all such experiments it is first necessary to determine the range of variability and from that to calculate the error to be allowed in all experiments.

High Tapping Results.

It will not surprise many of you to learn that the highest yield of rubber has been obtained from trees tapped from the base to fifty feet; these high-tapping experiments were modified and worked on such a plan that the yield has now totalled to about 15 lb. of dry rubber per tree in eleven months; there can be but little doubt that, if necessary, at the sacrifice of the tree, three times that amount could be obtained within one year. The cortical stripping necessary to give such a high yield, within one year, would in all probability kill the tree. You will notice that high tapping necessitates two or three coolies per tree per day, a fact which is of some interest to those planters who speculate on their future yields from parts of the stem above 6 or 10 feet.

There is a very curious phenomenon to be recorded in connection with the tapping of the higher parts of old trees. We all know that when a Para rubber tree stem has a basal circumference of 20 inches or over, it yields normal latex—or at least a milky liquid which can be converted into rubber. The average circumference of the stems at the highest points tapped at Henaratgoda, is not less than 30 inches, and the stems have usually yielded good latex. But on certain occasions the latex has been of such a nature that it could not be coagulated by any means whatever, and though this

CULLODEN ESTATE EXHIBIT.

feature has been very erratic, it has been of much more frequent occurrence where high tapping has been carried on. The following table shows the results for the last eleven months, and the botanical significance of this curious phenomenon will form the subject of future remarks :—

Marks.	Height of Tapping Area. ft.	No. of times when Latex not coagulable.	Number of times tapped.	Frequency of Tapping.
A	5–6	0	91	Twice per week.
B	,,	0	93	do.
C	,,	1	92	do.
D	,,	2	270	Every day
E	,,	0	136	Every alternate day
F	,,	0	44	Once per week
G	,,	0	11	Once per month
H	,,	1	171	Every day from Feb. 1
I	,,	5	257	Every day from Oct. 1
L	30	8	93	Tapped at irregular intervals
M	6–16	1	95	
N	10–20	1	94	
O	20–30	2	94	
P	30	16	78	
Q	50	5	84	

There is another interesting feature in connection with our Henaratgoda tapping, and that is, that the whole of the work has been done by untrained Sinhalese coolies with the minimum European supervision. My visits to Henaratgoda have been by no means frequent, and beyond spending a couple of hours every fortnight or month here, the work has been done entirely by Sinhalese villagers. I mention this in order to ward off the attacks of any critical visitor from other climes, who will naturally discover where the cambium has been cut only too frequently, and who must, therefore, feel inclined to suggest my decapitation as a fit punishment for the bad work done. However, you will see what can be accomplished by ordinary villagers, and how willingly the cambium of the Para rubber tree has tried to cover up the errors of the past.

Yields obtained at Henaratgoda.

Now I have pleasure in handing you the results obtained during our first year of experiment on a moderately large scale, and it is hoped that visitors from the Federated Malay States, the Straits, and India, will subsequently supply us with their records for comparison. Consider these results

as tentative only, and be prepared to forget them if future work proves them to be misleading ;—

Groups.	Marks.	No. of Trees.	No. of times tapped.	System of tapping.	Yield of Dry Rubber per Tree. lb.	oz.
1	A	25	91	L S	3	5
	B	25	93	H S	2	8
	C	25	92	F H	3	0
2	D	5	270	L S	11	0
	E	5	136	L S	12	8
	F	5	44	L S	3	13
	G	5	11	L S	0	10
3	H	5	171	L S	7	7
	I	5	257	L S	10	10
4	L	1	93	F H	14	8
	M	2	95	F H	8	11
	N	2	94	F H	12	3
	O	2	94	F H	8	11
	P	1	78	L S	10	14
	W	2	84	F H	15	0

L S=Long Spiral : H S = Half Spiral : F H = Full herring-bone.

In group 1 (A, B, and C,) the object has been to determine the relative value of different methods of tapping. the criterion being the yield of rubber per tree and per unit of excised bark. In group 2 (D to G) the object was to determine the yields obtainable when trees were tapped at certain intervals, varying from once per day to once per month. Group 3 comprises trees tapped at the beginning of October and February respectively in order to obtain some information on the relationship between the yield of rubber and climatic conditions. In group 4 (L, M, N, O, P, W) we have been making experiments with a view to determining the yield of rubber obtainable from different parts of the stem.

Viewing the Trees.

Ancient and Modern Tapping.

The party then proceeded to the oldest trees in the gardens. The largest tree was measured by visitors from India and the Federated Malay States and showed a girth, 4 ft. from the ground, of 109½ inches.

Mr. Parkinson remarked that the largest tree he had seen in the Federated Malay States was 103 inches.

Mr. Wright : What age ?

Mr. Parkinson : 22 years.

Mr. WRIGHT then pointed out a tree which had been tapped 10 or 12 years ago. It was one of those, he said, which had given an average yield of $1\frac{1}{2}$ lb. per year for a period of 9 years. The bark of the tree had expanded and become very gnarled.

Mr. PARKINSON : What system was it tapped on ?

Mr. WRIGHT : It was tapped on the V system. Of course, it could be done much better now than then on the same system.

Mr. DEVITT (Mysore) : Could you tap it now ?

Mr. WRIGHT : Yes, but it would be difficult to get an even line on the bark.

Dr. LEHMANN : How long is it since it has been tapped ?

Mr. WRIGHT: Not since Dr. Trimen's time, I think (ten years).

The trees that were then tapped, it was pointed out, were tapped rather high.

Mr. WRIGHT said the trees in this group were all the same age, but had not been equally treated. He did not think they would be able to tap higher than 6 ft., once they got their 250,000 acres in bearing.

Mr. PARKINSON pointed out that trees with thick stems such as these trees, branching off in forks at the top, were very liable to be split in two by the wind.

Proceeding round the garden the party came to a Para rubber tree with the top cut off. "You see here," said Mr. Wright, "rather a curious specimen of a Para rubber tree. We deliberately cut off the top of that tree to see whether it would throw out suckers and survive. The top was cut off on January 15 this year, and you see the growth that has taken place since then. It was simply done as an interesting experiment, and I am sorry to say it was misconstrued, and some people who saw it here went home and cut off the head of their 4-year old trees—for which I have, of course, received due blessing.

Mr. DOVE : I thought, perhaps, it was done on account of canker ?

Mr. WRIGHT : No. Just as an interesting pruning experiment. We have never tried experiments yet to see what amount of latex the bark of this badly treated tree contains.

A NEW TAPPING KNIFE.

Mr. T. L. SRINIVASAGAM, at this juncture, arrived with a new tapping knife, something similar to a gold medal winning knife shown at the Exhibition. The special feature of the knife is a boat-shaped bottom, which prevents it getting at the cambium.

Mr. WRIGHT gave the inventor permission to show his knife at work, and expressed the opinion that it was rather an interesting knife.

Tapping Experiments.

Mr. Wright then proceeded to the trees, the yields from which he had alluded to at his lecture. The trees marked C were those done by the full herring bone. Then they had the half spiral in the trees marked B, and the long spiral in A. The idea of these experiments had been to get some information regarding the value of each system of tapping, and, as he had mentioned in his lecture, the criterion, in the first series of experiments, was the yield of rubber per tree and per unit of excised bark. These trees marked C had been tapped on 92 occasions, and the measurement taken on the spot showed that in 92 tappings they had worked through only 3 to 4 inches of bark, approximately, in 11 months. The trees had been pared and pricked. Tapping on that principle they had gone approximately round one half of the tree, and it had given them an average of 3 lb. of dry rubber per tree. The long spiral gave 3 lb. 5 oz. and the half spiral 2 lb. 8 oz. That only showed the yield per tree, but they were trying to work out the yield per unit of bark excised.

Mr. Greig: What angle is this tapping done at?

Mr. Wright: The tapping was supposed to be done at an angle of 30 to 45°. This system of tapping gives us three lb. of dry rubber in a year and can be continued for four to six years.

Mr. Cameron: Does that afford ample time for the bark to become renewed?

Mr. Wright: I certainly think six years would be ample time to allow for bark renewal.

Mr. Parkinson: Starting a smaller tree, however, your surface would not last so long.

Mr. Wright mentioned that the rate would be the same—so many inches per month for so many tapping operations. The work here has been done by Sinhalese coolies.

Mr. Parkinson: And jolly well done, too!

The Half Spiral System.

The party then proceeded to the trees marked "B." They would notice, Mr. Wright remarked, that of the three systems they got the least rubber per tree in a given time by the half-spiral system, and they had approximately gone round half to one third of the tree. They could see on the tree where the pricker had been used.

Mr. Parkinson: Might I ask what tapping knives were used?

Mr. Wright: The Bowman-Northway and Miller knives were used on the trees A, B, and C.

Passing on to the trees marked A, Mr. Wright remarked that this was the full spiral tapping, which, worked at the same rate, would go completely round the tree in three years. In some parts of the Island they had adopted the spiral system and had completely stripped the cortex in a year. He thought it was a dangerous system to work. They could hardly expect the tree to stand being stripped of its entire bark so rapidly every year.

Mr. GREIG : When the pricker goes into the cambium it raises a lump.

Mr. WRIGHT : The pricker does touch the cambium, but I have peeled away a large piece of bark and I have been rather surprised to find there was practically no bad effect, although I expected there would be. Very often, however, with the rotating pricker the coolies work up and down the cut, macerating the whole of the tissues. I have not seen any very bad effects from the pricker when properly used.

Mr. GREIG : But does it not raise lumps ? I saw lumps raised by the pricker touching the cambium.

Mr. WRIGHT : You will see the effect of the pricker here. Continuing, Mr. Wright said : " We find it an advantage to leave as much bark as possible on the tree and reach the latex tubes by means of the pricker. I have seen a case where the paring was done very deeply, and where the cooly had gone very near, but not quite to the cambium ; when the dry weather came the bark peeled away, and the borers got in. You get it worse with Ceara than Para, for, as you know, the bark of Ceara peels away much more readily."

A Remarkable Stump.

Mr. WRIGHT then led the party to a remarkable Para stump not 4 feet or 5 feet from the ground, and cemented on the top. This, said Mr. Wright, is rather an interesting old stump. It is another of the trees which were tapped lightly on the V system many years ago. The principal part of the tree died down, and for the last three years the stump has been in this condition; so we thought we would take care of what remained and see how many biscuits we could make from it. This stump has never thrown out a leaf for over three years. This (pointing to the tapping marks) shows the difficulty of tapping over such an irregular surface. There is latex in it yet, and I think it is a remarkable fact that a tree stump which has never thrown out a leaf for three years should still give latex. Biscuits made from the latex of this stump are of good quality.

Mr. BRETT : Have you got any biscuits you have made out of this stump ?

Mr. WRIGHT : Yes ; they are here.

Mr. PARKINSON here tapped the tree and latex immediately began to flow. An exposed root was tapped by Mr. Proudlock, and the latex flowed freely while the wood looked quite fresh.

Mr. J. SHERIDAN PATTERSON asked Mr. Wright if the biscuits from this stump were as good as the rubber from other trees.

Mr. WRIGHT: In physical properties they seem the same.

HIGH TAPPING.

Mr. WRIGHT then led the party to the trees where high tapping had been carried on. At the first tree he said tapping was going on from the base to thirty feet. There were only two coolies working on ladders. The tree, Mr. Wright said, was marked L in the calculations he had given and had been tapped 93 times, and on eight occasions the latex could not be coagulated; that of course was rather interesting. In the 93 tappings it had given 14 lb. 8 oz. of rubber.

Mr. CAMERON: Over what period of time?

Mr. WRIGHT: From 26th September last year to the 30th August this year.

Mr. WRIGHT: In this series, L to W, the idea has been to determine the weight of rubber obtainable from various sections from the base.

At the next tree three coolies were working on ladders, and Mr. WRIGHT pointed out that they had not yet got half way down the tree. In about eleven months 84 tappings had given 15 lbs of dry rubber. That was the maximum yield.

Mr. CAMERON: What is the height of the tree being tapped?

Mr. WRIGHT: About fifty feet. You will see that we have only gone round one-half or one-third of the tree, and I suppose it is no exaggeration to say that we could get 45 lb. if we were prepared to kill the tree and we had the coolies to do it. We have been tapping sometimes on alternate days, and sometimes only once a week.

In reply to Mr. PARKINSON Mr. WRIGHT said the tapping has been carried on at irregular intervals on all trees marked W. All these trees were supposed to be 20 to 29 years old. The rubber-yielding capacity of the bark of course varied as they went upwards. He had not yet had time to work out the yields according to the excision of the bark in the different sections of the tree. That tree on five occasions gave latex that refused to coagulate.

The party next examined the tree marked M, which was being tapped from 6 to 16 feet. The next trees were tapped 10 to 20, and the next 20 to 30. The M trees had been tapped on 95 occasions, and had given an average yield of 8 lb. 11 oz. per tree from 6 feet to 16 feet. They wanted to find the yielding capacity of each section.

LATEX THAT WILL NOT COAGULATE.

The N, O, and P trees were then reached. Mr. WRIGHT remarked that there they had full spiral tapping from the base up to 30 feet on the trees marked P, which had been tapped on 78 occasions, and given an average yield of 10 lb. 14 oz. per tree; the number of times when the latex could not be coagulated was 16. That was the maximum number when the latex could not be coagulated.

Mr. PARKINSON: Have you any reason to account for that?

Mr. WRIGHT: It is very peculiar. The material seems to have the caoutchouc, but it does not appear to have the material for connecting it into one mass.

Mr. PARKINSON: Has the latex been chemically analysed?

Mr. WRIGHT: Yes, it has been sent to Mr. Bamber.

Mr. RYAN: Have you tried evaporating it?

Mr. WRIGHT: No, that would char it, would it not?

Mr. RYAN: I do not think so.

Mr. WRIGHT: Perhaps not; it is very interesting. If you take a young stem, you get a viscous substance that will not coagulate, but then that is only when the stem is a few inches in diameter; but the part of this tree from which we got the uncoagulable latex is 35 inches in circumference. The circumference of the narrowest part is much greater than that of six, eight, or even some ten-year old trees.

Mr. PARKINSON: In Ceylon.

Mr. WRIGHT: I beg your pardon, Federated Malay States. I do not know how you can explain it. You would expect the bark to be normal when the circumference is so large.

Mr. WRIGHT next pointed out another tapping above twenty feet, which had given 8 lb. 11 oz. per tree, with uncoagulated latex on two occasions.

FREQUENCY OF TAPPING.

The visitors were then taken to the division of trees where experiments had been carried out with the view of determining the frequency at which trees may be tapped with the best results.

Mr. WRIGHT explained that the trees marked D, which were first viewed, had been tapped up to 6 feet only, every day from September 25th of last year. They had been tapped on 270 occasions. The lines were originally twelve inches apart, and only on two occasions had they got latex which had refused to be coagulated. This had proved far too rapid a process of excision altogether. He would next take them to the other trees marked E, with which he was making a

comparison. The latter has been tapped on alternate days and had given 12 lb. 8 oz. in 136 tappings, whereas those tapped daily on 270 occasions had only given 11 lb. That was a curious result. In the daily tapping they had cut through the whole of the bark. If they studied the nature and origin of the latex tubes of Para rubber they would find that the whole matter was a question of time and decomposition. They might cut the bark one day and find no latex. If it were allowed to remain a sufficiently long time for decomposition to be effected, they finally obtained latex. Evidently in tapping daily they cut through the bark at too rapid a rate for the developing capacity of the laticiferous system.

In reply to a question Mr. WRIGHT said they used the paring knife and the pricker alternately in each case. They saw there what they might expect if they tapped 270 times in eleven months. He would certainly not propose to tap the renewed bark under three or four years. One cortical stripping every four or five years was quite enough. They saw the effect on the bark. It was drying and was quite sound underneath.

Mr. RYAN : Are you in favour of dressing the bark of the trees with any preservatives ?

Mr. WRIGHT : I do not see why you should ordinarily do so. In special cases it might be useful.

Remarking upon the state of the bark, Mr. WRIGHT said they saw there a sample of the work done by the Sinhalese cooly. They would probably see one or two cases where he had cut into the cambium, but he did not think there were many such instances. He would like to know how it compared with work in the Federated Malay States.

Mr. DOVE : It is very good work.

Mr. PARKINSON : Very good, indeed.

Mr. DEVITT cut into the bark of the tree which had been tapped daily and found that the renewed bark measured one-fourth of an inch.

Mr. WRIGHT : That is very interesting. That has taken eleven months to this date to develop.

The party then examined the trees which had been tapped on alternate days, and Mr. Wright said they would see that they still had approximately one-third of the original bark—which was the mother of all rubber—left after obtaining 12 lb. 8 oz. of rubber against 11 lb. in 270 tappings in the other trees. Further, here they had only tapped 136 times against 270 in the other case, so that the cost of labour was one-half. He thought personally that was the most interesting result they had obtained up to the present. He did not know whether

the labour difficulty would permit them to tap on alternate days. Would it be possible in the Federated Malay States ?

Mr. PARKINSON : Yes.

Mr. WRIGHT added that they had made experiments in tapping once a week and once a month. Coming to the trees which had been tapped once a week he said from 44 tappings they had obtained an average of 3 lb. 13 oz. per tree. Not on a single occasion did they obtain latex they could not coagulate.

On arriving at the trees that had been tapped once a month Mr. Wright said they had tapped on eleven occasions and got 10 ounces of rubber, or nearly $\frac{3}{4}$ lb. of rubber, per tree, approximately. They had now seen the trees tapped from once a day to once a month. If Mr. Parkinson's assertion was applicable to Ceylon—that they could tap on alternate days—the prospects for rubber planters were very favourable. These trees showed what they might expect tapping at the rate of once per month. They might go on for ten or twelve years at that rate.

LANDOLPHIA RUBBER.

Mr. WRIGHT then took the visitors to see the Landolphia rubber creeper growing in considerable abundance in a part of the grounds, and spreading its vines all over the neighbourhood. On a thick part of one of the vines being cut latex flowed more freely even than in Para rubber and coagulated rapidly.

Mr. WRIGHT remarked that Landolphias grew only among jungle trees. They must have some trees upon which they could climb. The best method of extracting the latex was probably maceration. Those specimens were probably fifteen years old. The bark was fairly thick, and the rubber was very good in quality.

Mr. PROUDLOCK said he got excellent rubber from it at Nellamore in 1903.

Mr. WRIGHT : Have you any idea of the rubber contained, say, in a cwt. of bark?

Mr. PROUDLOCK : I have the results tabulated. The percentage is very high—I believe from seven to eight per cent.

LATEX DEMONSTRATION : COAGULATION BY ACIDS.

After going through the plantation the party returned to the laboratory, where Mr. WRIGHT gave a brief demonstration of the treatment of latex. Mr. WRIGHT said :—We have all heard lately about the difference in the physical properties between rubber obtained from five, six, and thirty-year old trees. I have here samples from trees $29\frac{1}{2}$ years. The biscuits were handed round and tested and proved to be of excellent strength and resiliency. These have all been treated

with a little formalin, but they are not smoked. We have now gone through practically every process connected with rubber cultivation at Peradeniya and Henaratgoda. You have seen the trees that have been tapped, and got information regarding the yields obtained, and so on, and you have seen every development at Peradeniya in the manufacture from the latex. There is very little of interest left to go over, except to describe a few of the characteristics of fresh latex.

Mr. Wright then experimented with a quantity of latex to ascertain the amount of acid required to effect coagulation. He remarked that the latex, as it came from the field, or as it issued from the tree, was either neutral or a little alkaline. Mr. Wright dipped red and blue litmus papers in the latex, and asked them to notice that blue remained blue, and red remained almost the same. It was almost a neutral solution. So long as it remained in that condition coagulation would not take place. If they wanted to coagulate the latex they must either let it stand to allow the acids to develop or use some acid. In adding a quantity of acid it was always advisable not to use more than was absolutely essential. Washing eliminated a certain portion of it, but if they determined the quantity by means of litmus paper, he thought it would do away with a good many of the objections that were put forward by people at home to the use of acids. The point was to add just sufficient acetic acid to neutralize the latex —until it was just on the turning point, and then allow it to settle

Mr. Ryan : What proportion of acid ?

Mr. Wright : You never know that proportion beforehand, because the composition and acidity or alkalinity of the latex varies very much.

Mr. Wright : then demonstrated with blue paper, adding acid until it began to get red.

The Effect of Water.

Mr. Cameron : May I ask what proportion of water is in the latex ?

Mr. Wright : A very large proportion. Pure water makes no difference to the rubber. Many people have used impure water, which has predisposed the rubber to tackiness. Continuing, Wr. Wright said that in future their programme would be considerably changed. They have now arrived at the stage when they could safely despatch their latex to Peradeniya. Formerly the foreman prepared the biscuits at Henaratgoda. Now their latex would be sent to Peradeniya and manufactured there, so that they hoped to make good samples of rubber and to carry out much more useful experiments.

Mr. FIELDING: How do you preserve it on the way?

Mr. WRIGHT: By the addition of ammonia or formalin.

Mr. FIELDING: Does it matter how much?

Mr. WRIGHT: You soon get to know how much you want. It depends a great deal on the condition of the latex at the time it is put in the accumulating tins.

Mr. PARKINSON: Do you ever find that for a natural coagulation, it takes longer when you have a large quantity of water?

Mr. WRIGHT: I cannot say I have had that experience. Have you?

Mr. PARKINSON: I have found it so, and I think you will find it so.

Mr. RYAN: My experience is the same as Mr. Parkinson's.

Mr. WRIGHT: Some latices may be coagulated by adding water or boiling—Funtumia for instance.

The party then adjourned to the Resthouse, where lunch was provided.

Apart from its general interest, one or two points of considerable importance are brought out in this discussion. Chief, perhaps, is that no one system, whether full spiral, half spiral, or herring bone, has as yet established itself as unquestionably superior to any other. The chief thing, perhaps, to be attended to, is not to cut away the original bark—the mother of rubber, as Mr. Wright has termed it—too rapidly, for the general opinion about the renewed bark is that it takes from three to five or six years to form fully in such a ripe manner as to allow of proper tapping. Many estates have cut away their original bark in too reckless a manner, and are now finding that they will have to wait a considerable period before they can resume tapping. Some of the Henaratgoda experiments show that with care the tapping need not cut away all the original bark until the renewed bark has fully ripened; and this is a matter of great importance. On the whole, the full spiral seems the most dangerous method of treatment of the bark, but between the half spiral and the herring bone it is difficult to decide. These experiments, to determine the best ways of tapping, and which way gives the greatest amount of milk per unit of bark cut away, will be continued at Henaratgoda, being of great importance.

We may now pass on to the lectures by Messrs. Green and Petch upon the prevention of disease in rubber plantations, calling especial attention to what they say upon the advisability of every estate keeping always in hand a supply of simple apparatus and materials for instantly dealing with an outbreak of disease.

Lecture on Rubber Diseases.

By Mr. E. E. GREEN and Mr. T. PETCH.

A joint lecture on rubber diseases was given by Mr. E. E. Green, Government Entomologist, and Mr. T. Petch, Government Mycologist. His Excellency the Governor presided.

Insect Pests.

Mr. GREEN said: Ladies and Gentlemen,—I see that the subject posted against my name to-day is "Prevention of Diseases." This is rather too wide a term for what I propose to bring before you. It is not my intention to lecture at length upon individual diseases or pests, but to put forward a few remarks upon general preventive measures against diseases of the rubber plant, and to invite a discussion upon the question. I myself can touch upon half of the subject only—that of the insect pests. My colleague—the Government Mycologist—will presently take up the theme and suggest means for the prevention of the fungous pests, which—at present—are of considerably more importance. The Para rubber plant (*Hevea brasiliensis*), which chiefly interests us in Ceylon, is self-protected against most insect pests by the copious exudation of viscid latex that follows upon the slightest wound to the bark. This protection is efficient only so long as the plant remains in good health. Anything tending to reduce or arrest the flow of latex will render the plant more subject to attack. The function of the latex in rubber plants has frequently been a subject for discussion, the important question being whether it is an excretory product, and not distinctly concerned with the nourishment of the plant—in which case tapping operations should not interfere with the proper development of the tree—or whether it contains a reserve food supply. I believe that the former view (that of the excretory nature of the latex) is the one adopted by most scientists at the present time. Mr. Bamber, in his lecture delivered this morning, suggested that the small quantities of sugar and proteids found in the latex as drawn from the tree may be due to the accidental admixture of the sap of the plant that must exude at the same time. Though not of primary importance to the organism, it must not be supposed that excretory products are of no value to the plant. They frequently serve an important *rôle* in the protection of the plants from their natural enemies and—from my experience—I am inclined to the belief that this is *one* of, if not the *principal* function of the latex in our rubber trees.

As an instance of the protective value of the latex of the Hevea, I may mention a case that has recently come under my notice. A boxful of Longicorn beetles, with a bundle of

young rubber stumps said to have been killed by them, was sent to me for report. The bark of these plants had been gnawed off, in large irregular patches, exposing the bare wood. When specimens of damaged plants are submitted with a specific statement of the cause of injury, experience has taught me to first look for a different cause, and in this case I found the roots to be attacked by a parasitic fungus pronounced by the Government Mycologist to be his recently discovered *Botryodiplodia elasticae*. It has always seemed to me extremely doubtful that a healthy rubber plant, protected by the natural flow of latex, could be successfully invaded by bark-eating and boring insects, so I determined to make these particular beetles the subject of experiment. Several of the living insects were confined in a large cage together with a healthy growing plant of Hevea of the same age and stage of growth as those which had been the objects of the attack. The beetles crawled up the stem and presently tried their jaws on the bark. The puncture resulted in an instantaneous exudation of latex which adhered to the mouth parts of the beetles and was evidently very distasteful to them. They promptly abandoned the attack and spent some time in endeavouring to remove the sticky fluid. After the first rebuff no further attempt to feed was made—even under stress of starvation. After seven days' confinement without other food, they were placed in another cage with partially dried rubber plants and twigs of non-laticiferous trees, upon which they commenced to feed greedily.

These experiments clearly indicate that a healthy rubber plant is in general immune to the attacks of bark-eating beetles, and it is very probable that boring beetles would fare equally badly in any attempt at penetration. But should the laticiferous ducts become dry, from disease or any other cause, the plants will fall an easy prey to their insect enemies. Stumped plants that have been despatched by rail for long distances, and have become partially withered during transit, will be especially liable to attack. It is conceivable that excessive tapping —particularly of young trees—leading to temporary exhaustion of latex in the bark—may similarly react upon the health of the tree by facilitating the invasion of the tissues by boring insects and—through them—of even more dangerous fungal enemies. It is, however, young plants of the first and second year that are most liable to attack, and as a general preventive measure against disease in such cases, every means should be employed to ensure an unchecked healthy growth from the time of germination until the plants have passed their susceptible period. In my opinion a very large proportion of disease in young plants is the

outcome of injury (either direct or indirect) at the time of transplanting. As forms of such injury may be mentioned mutilation of root; bruising of the tender bark, especially around the collar; too long exposure during transport; and unsuitable planting weather. Most of these dangers may be avoided by growing the plants in supply baskets.

At present we have comparatively few insect pests of the Hevea in Ceylon. But it would be foolhardy to expect perpetual immunity. The history of every cultivation has shown that, with increase of area and lapse of time, new pests arise—attracted by the altered conditions and an abundant supply of food. Our system of exclusive cultivation of single products, though convenient for economic purposes, lends itself to the rapid spread of pests and calls for special measures to meet this liability. Plants in their natural state—where numerous orders, genera, and species are intimately mingled together—are not nearly so subject to the ravages of disease. Apart from the physiological benefits of commensalism—now becoming more generally recognized—the more or less complete isolation of individual species that occurs under natural conditions is itself a check to the extension of disease.

These facts lead up to the consideration of what I look upon as by far the most important part of my subject, that of *insulation*. During the six years in which I have occupied my present position, and the many previous years of practical experience as a planter, I have been impressed with a sense of the immense difficulties that lie in the way of combating any serious insect pests where no efficient means of isolating any particular area for purposes of remedial treatment are present. The task has seemed a hopeless one, and has too often proved an impossible one. What are the conditions that prevailed during the reign of coffee and that are now equally or even more pronounced in the age of tea? We find vast continuous tracts of land planted with a single product, unbroken by either natural or artificial boundaries, and affording no hindrance to the free distribution of any infectious disease. Under such conditions how can we hope to effectively deal with our insect enemies. Vigorous measures may be employed and a pest may be temporarily exterminated on a limited area; but the disinfected parts are immediately liable to fresh invasions from all sides. Given an isolated field we can deal with a pest with some confidence that our labour will not be quickly nullified. I would most earnestly urge our rubber planters to take warning from the mistakes that have been made in the cultivation of the older staple products of Ceylon.

The remedy lies in the formation of protective belts or boundaries of either jungle or cultivated trees. Such belts should be at least 30 feet in depth and composed of close growing trees with a good cover of foliage. As in most trees the lower parts are bare of foliage, a separate undergrowth will be necessary to ensure an effective screen. It is also important to understand that the trees and shrubs composing the belts should be of kinds differing as widely as possible from the plants that are to be protected by their means. Insects, though seldom dependent upon a single species of plant for their nourishment, very generally confine their attention to distinct groups of nearly related species and genera. If the protective screens are composed of trees belonging to a distinct natural order, there is much less chance of the inter-communication of pests. It is not my province to decide what particular species should be employed for the purpose. That is a matter that must be determined by the botanists, and will be affected by considerations of climate and altitude. The anticipated profits from a single rubber tree are so great that proprietors are tempted to plant up every available spot and are unwilling to allow a single yard of suitable soil to be occupied by what they would consider to be unprofitable growths. This is surely a very short-sighted policy: but to meet their view I would suggest that screens composed of other species of rubber—for example, Rambong and Castilloa—might be interposed between adjacent fields of Para rubber. Both Rambong (*Ficus elastica*) and Castilloa are members of the family *Urticaceae*, while Hevea belongs to the distinct family *Euphorbiaceae*. We do not, at present know very much about the productiveness of these two kinds of rubber in Ceylon, but any yield that they may possibly give should be looked upon as a perquisite, their true value being as a means of insulation to the more valuable Hevea plants. I may mention that the Ceara rubber is a close relative of the Hevea, and is consequently unsuitable as a component in the protective screens. As an undergrowth—in combination with Rambong and Castilloa—tea and coffee might be tried, or some plan the clippings of which might be employed as green manure. Cinnamon would make an almost ideal screen as undergrowth.

There is another matter that is intimately connected with my subject of prevention, and that is, *preparation* for possible attack. At present, when any special treatment is advised, serious delay is incurred in obtaining the necessary material. Every estate is provided with a stock of medicines for use in cases of sudden sickness amongst the labourers. It is no less important that the health of the plants—upon

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which the labour depends—should be equally well provided for. Every estate should maintain a stock of insecticides and apparatus for their application—ready for every ordinary emergency. Such an outfit should at least consist of the following materials :—

Paris green	..	.. 2 cwt.
Sulphur ..	..	.. 2 ,,
Whale oil soap	..	.. 2 ,,
Lime ..	..	.. 50 bus.
Sulphate of copper	..	.. 1 cwt.
2 knapsack spraying machines (for liquids)		
2 ,, ,,	..	(for distribution of powders)

Precautions against Fungus Diseases.

Mr. Petch said : As there always seems to be some doubt as to the duties of the people who have to support the burden of these long names, I may take the opportunity of postulating that the Mycologist deals with fungi only, and that the remarks offered at present are to be understood as referring only to fungus diseases. At the same time, I should like to express my entire agreement with the suggestion that the Hevea acreage should be broken up into small blocks by belts of other trees. The reservation of forest belts in the F. M. S. is one of the most important advances in disease prevention that have ever been made. There is unfortunately no similar policy in Ceylon, and that renders the adoption of the method suggested by Mr. Green still more imperative. It may be as well to note at the outset two fallacies in connection with diseases of Hevea, which have obtained a rather wide currency. It is often stated that the periodic leaf fall confers an immunity against leaf-disease. That is quite a mistake. If it were true, leaf diseases would be practically unknown in temperate climates, whereas, as far as is known, they are more abundant there than in any other region. On a deciduous tree, a leaf disease lives half its life on the living leaf, the other half on the dying or dead leaf, and then rests in the dead leaf until the new leaves appear when it attacks them with renewed vigour. That refers to fungi with two distinct stages in their life-history, but there is no immunity for Hevea even from fungi which must always live on living leaves, for it seems quite evident that tapping alters the time of leaf fall, and there will always be some trees in full leaf. Immunity from fungus diseases is also supposed to be bestowed on Hevea by the presence of latex. There is not the slightest

reason to suppose that a fungus thread cannot grow in a latex tube, and even if that were the case, a fungus hypha could pass between two latex tubes just as easily as you can walk down the central drive. I am afraid you will think that this is disease encouragement rather than disease prevention, but I want you to understand that there is no feature in Hevea which makes it immune to fungus diseases, and that it is not unnecessary to keep a careful look-out for such diseases. Fortunately rubber planters as a whole cannot be charged with neglect of this duty, and they do not at all object to cut out trees when necessary, probably because in some cases their programme involves the destruction of half their trees after five years.

Where disease prevention seems to me to be most required is in the early stages—in the nurseries. The general view is that a few seedlings are of no importance, but if you had to read the large number of letters which are received relating to failures of nurseries, not only in rubber, but in tea, cacao, &c., I think you would conclude that there is something wrong with the system. The usual thing is to blame the seed, but I do not understand why seed in Ceylon should be so different from seed in other countries. The preparation of seed-beds and the care of nurseries is more of a gardening operation than is the usual routine work of a plantation, and the situation reminds me very forcibly of the case of the English small farmer who can grow good field crops, but who makes a hopeless failure of his vegetable garden. He considers that gardening is too trivial. In Ceylon, the site of a nursery is usually governed by the water supply, and the same ground is used for nurseries continously. That, I believe, is one of the chief reasons for the failure. Fungus spores accumulate, and a disease which kills off only twenty plants in one batch, may easily multiply to such an extent that it destroys 2,000 of the next.

The position of the nursery should be changed, or, if that is impossible, the ground must be sterilised by lime or other substances before the next planting. In some cases it may be necessary to let the land lie fallow, and to weed and burn the weeds periodically. In Saturday's discussion, the question of large and small seeds was briefly referred to, and it was stated that in one instance a plant from a small seed was bigger than those from larger seeds. I am afraid that a single instance is hardly sufficient to theorise upon, but I should like to call your attention to, and ask you to confirm or refute the opinion that the seeds from regularly tapped trees are smaller than those from untapped trees. I have been informed by a planter, who weighs his seed regularly, that whereas 1,000 seeds from

his trees formerly weighed 10 lb. they now only average 7 lb., but a more interesting point in the same discussion was the statement that, in the case of tea, it had been found that immature seed gave a higher percentage of germination and apparently better plants. Now, I am not aware that there is any theory to explain that, but it is a well-known fact. The use of immature seed is one of the methods of producing early varieties. The plants grow better at first, and flower and fruit earlier than the parent plants. Please understand that I am not advocating the use of immature seed for early rubber production ; that is quite another matter. It is the fruiting period which is accelerated. The point that concerns me is that these precocious trees are less hardy, less resistant to disease than their parents. It is the usual fate of prodigies. I must, therefore, urge that mature seed only should be used ; and the only certain sign of the maturity of the seed is the splitting of the capsule or seed pod. As a rule, seed is gathered off the ground and is mature ; but I have seen an instance in which one set of coolies gathered the green pods and another gang sat on the path and broke them open. That practice should be stopped.

The question of canker is not troubling us much at present, but it is a factor which must be considered in connection with the proper distance for planting. Our present freedom from this disease is, no doubt, due to the fact that most of the old rubber is planted widely through tea. The worst attack of canker occurred in the Government plantation at Yatipauwa, where the trees were twice as close as they should have been. It may be as well to look a little ahead and consider the probable effect of some proposed planting methods. One method involves the destruction of half the trees after five years to leave room for the full development of the remainder. On almost my first visit to a rubber estate, I was much struck by a block of close-planted trees which were evidently not big enough for tapping, and I asked the Superintendent what he intended to do with them. "Oh," he said, "we are going to cut out half of them : we have been going to do it for the last two years, but we never do it." And I venture to suggest that so long as a census of trees is the chief feature in a report, closely planted trees will not be cut out.

But assuming that this is part of the recognized procedure of the estate, how do you propose to do it ? Will you fell the trees, or will you tap them to death ? If the latter, do you expect them to die at once, or to linger on for months ? And will they die of sheer exhaustion, or will they be assisted out of existence by the attacks of fungi ? It is almost certain that if you attempt to tap to death alternate trees every

one of them will be attached by fungi, and you will have as many centres of disease as you have sound trees. The only rational method of thinning out would be to uproot the superfluous trees, and to extract the rubber by means of one of the washing machines. It can be decided at the present time whether this would pay. Judging from the closely planted areas which have come under my notice, I should say that the trees will take a year longer to attain a tappable size, and in that case nothing will be gained by close planting and thinning out, except a greater liability to disease.

Finally, there is the question of preventing the attacks of the only disease which is at present serious—the root disease caused by *Fomes semitostus*. This was brought to my notice last year, when roots covered with white mycelium were sent in. In this stage the fungus was not identifiable, but by suitable treatment, the fructification was cultivated, and its identity and life-history determined. Consequently, when it began to be apparent that the disease was fairly wide-spread, and alarming rumours were current in Colombo, the Department was in a position to state how the disease originated and what steps must be taken to prevent it. The illustration of this fungus will give a better idea of it than any description. I may say that specimens of the various fungi attacking Hevea may be seen in the laboratory ; the announcement of that fact in the programme of the Exhibition is rather obscure. *Fomes semitostus* always develops first on jungle stumps and spreads from them to the Hevea by means of white threads in the soil. There is no case in Ceylon of a direct attack on Hevea, and the fructification has never been found on Hevea in Ceylon except in the case of those cultivated for the purpose at Peradeniya. The spores of the fungus are blown on to the jungle stump and develop there until the stump is partly consumed. The mycelium then spreads to the neighbouring trees, and at the same time advertises its presence by producing its fructification on the stump. I have never yet found any difficulty in deciding which stump the fungus originated on. The method of prevention is obvious, though it may be expensive. Jungle stumps must be removed. Every stump invites the attack of dozens of fungi, and it is extremely fortunate that the majority of these are harmless. In many cases these harmless fungi destroy the stumps, and after that *Fomes semitostus* has very little chance. For this reason, the disease does not attack plantations in which the jungle stumps have entirely decayed, and it does not occur on Hevea planted through tea. It also follows that the disease is most abundant in plantations one to three years old. Jak stumps particularly favour its growth.

The advice that jungle stumps should be removed evoked a valuable newspaper correspondence. I will deal with the suggestions in a moment, but I must first of all point out that the small stumps are not affected: the problem is how to get rid of large jak stumps about three feet in diameter, with surface roots spreading several yards on every side, and we require a process which can be carried out after planting. The danger might be diminished by felling trees at a lower level than is the custom at present: two feet six inches from the ground appears to be the usual height, but anything up to four feet may be found. There is, of course, more work in felling at ground level, but the decay of the stump would be more rapid. One suggestion was that the stumps should be treated with some chemical which would prevent their decay—that they should be mummified. Now, the only reasonable method of preserving wood is to creosote it, and that is of course impossible with stumps in the ground. In any other process the chemical would have to soak into the wood, and it would just as readily soak out again, probably to the injury of the trees in the neighbourhood. Besides, unless the process were repeated at comparatively short intervals, it would only mean postponing the attack of *Fomes semitostus* until the rubber was older. The disease is soon evident on a young tree, but it might spread to a considerable distance from an old tree before its effect on that tree was observable. Catch your fungus when the trees are young. The Australian method of burning out stumps was also suggested. This is done by boring several holes in the stump, putting in saltpetre which soaks into the wood, adding kerosine when this is dry, and then setting fire to it. The objection to this method is that in many cases the stumps are never dry enough to burn. The correspondent who quoted a description of this process omitted the fact that the stumps never burn away completely, and that much labour is always necessary to cut out the remainder. Under the supervision of any one who understands explosives, blasting would probably give the best results. Five methods were suggested by correspondents, all from personal experience, all different, and all contradictory. I have not had any experience in this line and cannot assume the responsibility of recommending any particular process. Gold medals were offered by the Committee for the best apparatus and the best method for removing stumps. For these there has been only one entry, and the inventor of the apparatus has altogether under-estimated the magnitude of the stumps. Trees up to a foot in diameter can be easily uprooted by the Trewhella monkey-jack or

some similar apparatus. Before the circular on root disease was issued, these various suggestions were submitted to the planting members of the Experiment Station Committee, and it was their opinion that the cheapest method in Ceylon was to cut out the stumps in the ordinary way. That explains why they were not incorporated in the circular. Jungle stumps must be removed if root disease is to be prevented. The closer the trees are planted, the greater chance there is for root disease to spread. The mycelium has a shorter distance to travel and the roots come in contact sooner. The suggestion that the lateral roots of Hevea grow at the rate of about 1 foot per year has been exaggerated by the newspapers into the statement that it has been found at Peradeniya that the lateral root system spreads at the rate of one foot per year. Nothing of the kind has been proved; in fact, the only recorded evidence is to the contrary. I have superintended the uprooting of a considerable number of Hevea trees, and it seems to me that to assign a limit to the annual growth of lateral roots is about as reasonable as Canute's attempt to stop the tide. The special recommendations I wish to emphasise are :—(1) Pay more attention to nurseries; (2) Do not use immature seed; (3) Get rid of jungle stumps; (4) Do not be in too great a hurry to adopt schemes of planting which involve extensive "thinning out."

The Discussion.

Precautions taken in the Federated Malay States.

His Excellency the Governor: I am sure Mr. Carruthers will be glad to make a few remarks on the papers we have heard?

Mr. Carruthers said that his only regret was that the meeting that afternoon did not include every planter of rubber in Ceylon and the Federated Malay States, for he was quite sure there could not be any more important subject to be brought before them; and if every planter hearing Mr. Green and Mr. Petch were convinced that the present, what they must call haphazard methods of planting were unlikely to continue and were to look forward to what must come in the future, it would be to their benefit. The immunity of the trees from disease could not continue, and he was very glad Mr. Green and Mr. Petch had both laid down the maxim that every planter must realise this and must have on his place a stock of preventives and machines for dealing with disease, so that if disease breaks out they may at once deal with it. His experience in Ceylon was that a man rode in and said he had a thousand trees affected with a certain disease. You visit the

place and he tells you that a month ago only ten of his trees were affected and it had now spread. You ask him why he did not get at the disease at once, and he replies that he had no stuff by him, he had no sprays, and he did not know what to do. They must have all these things ready at hand, so that if disease broke out they may be applied to the trees at once. With regard to close planting and the proposal to thin out the trees, he was extremely glad Mr. Petch spoke plainly. The planter said he was going to thin out, but he did not do it. and with rubber at 6*s*. per lb. there was not much likelihood of his doing so. He, Mr. Carruthers, had cut out some 6,000 trees from the Government plantation at Yatipauwa. His Excellency was not in the Island then, so that he could not blame him for sacrificing so much Government property.

HIS EXCELLENCY the GOVERNOR: I remember hearing that the trees were cut out.

Mr. CARRUTHERS said he did not think any planter would have cut out 6,000 trees 14 years old. It was certainly very important to remember in cutting them down what risks they ran in so doing. He thought any one who studied the diseases of plants would at once admit they ran a serious risk. With regard to the prevention of disease, preventive belts was a subject on which he was extremely keen. Mr. Green mentioned the matter, he thought. He had laid out a belt cutting off two large areas. This large belt of jungle, 16 miles long and two miles broad, would be reserved. That belt included a good many *bukits*, the Malay word for hill; and the barrier formed by the belt was, therefore, higher than if it were on the flat. Many planters felt very much aggrieved and said he was locking up good land, but he hoped they would keep that large barrier. There was no doubt, however, that each planter should have his own preventive barriers, and do things in a small way for himself to prevent disease.

HIS EXCELLENCY the GOVERNOR: Perhaps, Dr. Willis could tell us what the effect was on the trees remaining after 6,000 had been cut out at Yatipauwa. At the time, I remember, there was a proposal of a gentleman to continue to lease that ground and deal with the canker himself, and my feeling was that, at whatever cost, the canker should be destroyed, and I would like to know what the actual result was when the trees were cut out.

Dr. WILLIS said the plantation was in the hands of the Forest Department, and he really did not know, but he understood it was in a good enough condition. He had heard of it from Mr. Campbell about eight months ago, but not recently.

Mr. CARRUTHERS said it might look like blowing his own trumpet, but he had a talk with the Conservator of Forests.

who told him the plantation was now in a fit state to be taken up by any one. He would rather have left that for some one else to say.

Question of Thinning Out.

His Excellency the Governor: I do not know whether any of you, gentlemen, in any of your lectures, have spoken before on this question of close planting and taking out a certain number of trees thereafter.

Dr. Willis: I do not think so, Sir. It is a very important question at the present moment, and I would be very glad if some of you gentlemen would make some observations on the point. I have heard a proposal put forward that it was not a bad thing to plant the rubber 10 feet apart instead of 20 feet, and at the end of 4 or 5 years to take up every second tree and obtain by maceration all the latex in it, leaving the remaining trees 20 feet apart. I think if any information could be given on that it would be very interesting in connection with this discussion.

In connection with the question of close planting, it might be interesting if he briefly recapitulated the history of it in Ceylon. Of course, the whole of the rubber pioneering had been done by his own department, and years ago they were strongly of opinion—basing their ideas on the work done by forest departments in various other parts of the world—that close planting would prove to be the best. The object was to get tall, straight boles and get as much wood as possible out of them. It was an axiom in forestry that the best way to do that was to plant close and thin out afterwards, and from a purely theoretical point of view that was the best way to treat the rubber tree. But their experience was that a man was not willing, after he had 300 trees growing on an acre, to thin it out and admit he had 150. In the second place Mr. Petch had told them that when they began cutting down trees, the other trees about them were very liable to be attacked by fungus disease. Undoubtedly, the best way to take it away is to remove it bodily, but the best thing was not to put them in at all, because, when they were taken out, they were almost entirely valueless from the point of view of rubber production. At one of their regular weekly departmental conferences the department, as a whole, decided for wide planting rather than close planting, and they no longer recommended that planting should be done 10 feet by 10 feet or 12 feet by 12 feet, but were inclined to recommend 20 by 15. That must vary a good deal according to the quality of the soil, but, as a general average, they had collectively voted 20 feet by 15 feet. That was about 150 trees to the acre, while formerly 12 by 12 gave 300 trees to the acre.

Dr. LEHMANN remarked that the process of trenching round the trees had been fairly successful in regard to the root disease of *Rosellinia* in Mysore. He would like to have Mr. Petch's opinion as to whether that method could be applied here with regard to root disease affecting the *Hevea brasiliensis*.

Mr. PETCH replied that what we wanted to do with regard to the root disease which he had found in Ceylon, was that all the old stumps should be taken out and so prevent it altogether. This root disease must come from the stumps, and he wished to avoid it altogether by removing the stumps and not wait until it became necessary to resort to trenching. Of course, trenching was the only way they could stop the fungus spreading once it had commenced.

HIS EXCELLENCY: What is really of cardinal importance and interest, I take it, in regard to this question is whether young trees—what do you call a mature tree for rubber purposes?

Dr. WILLIS: Six to seven years old.

HIS EXCELLENCY: Well, we will take a four-year-old tree as immature. Do we understand from your observations that it would not pay to uproot four-year-old trees and extract the latex from them by maceration or some other process? Do you think you can get from those trees rubber that will be of commercial value?

Mr. PETCH: My point is that by this close planting the remainder of the trees on the whole plantation would be a year behind, and the amount of rubber you get from the four-year-old trees which you cut out will not recompense you for the year lost.

Dr. WILLIS observed that, in regard to young trees, Mr. Parkin, when he was in Peradeniya, worked it out, and he found that until the trees were five or six years old the amount of rubber was very small. You could get a milky latex from seedlings, but the substance which gave the milkiness was not caoutchouc. The amount of caoutchouc was not appreciable until the tree was five years old, when you got a good quality of rubber. You would not get really good quality rubber by cutting down four-year-old trees. You might get say, 3s. a lb. for that at present, but certainly not 6s. a lb.

HIS EXCELLENCY: Then, as a factor in valuing an acre of rubber, I presume that the distance at which the trees are planted is a very considerable one?

Dr. WILLIS: Yes, in arriving at the actual value. When the trees were widely planted they would be more valuable at five years than if closely planted, although the trees planted close would have straighter boles.

Mr. PROUDLOCK said he had been very much interested in what had been said about the value of rubber from young trees. His own experience was that rubber from trees was not of good quality until the trees bore seed or until they had formed seed. After that the rubber was fairly good; before the tree bore seed he found it was of very little value. In the case of Castilloa and Hevea the trees bore seed when about six or seven years old. In the case of Ceara they bore seed at 1½ year, and when they were 2½-year-old they could get very decent rubber. In regard to the advantage or disadvantage of close planting, he was quite in favour of wide planting. Of late years he had planted Ceara, Para, Funtumia elastica, Ficus elastica, and a few other kinds, which had not much value, at 30 feet apart in comparative lines with the view of finding out eventually what was the best distance to plant rubber trees, and to see what their development would be ten or twenty years later. In the meantime they were utilising the ground between the rubber trees by planting catch crops. They had planted several fibres, sisal-hemp, tapioca, pineapples, manila-hemp, as well as sweet potatoes and ordinary eating plantains. That was to say, they cropped the land until the rubber trees came into bearing, the object being to show how planters might obtain some return from their land which was occupied by rubber trees widely planted.

HIS EXCELLENCY: Then we are to understand, I take it, that a census of rubber trees, without the information as to the distance at which they are planted apart, is not a reliable measure of value.

Mr. KELWAY BAMBER: Absolutely not.

Mr. ZACHARIAS: I may say that the United Planters' Association of the Federated Malay States every year has a census made showing the acreage under rubber. When we started doing that there was a long discussion as to whether we should ask for a return of the number of acres or the number of trees, and it was decided in favour of acres only, because it was felt that the total amount of rubber obtainable from one acre was practically the same at whatever distances the trees were planted.

HIS EXCELLENCY having expressed thanks to Mr. Green and Mr. Petch for their papers, the meeting separated.

The extension of Rubber Cultivation.

We may now pass on to the lectures dealing with the extension of rubber cultivation, which is proceeding very rapidly, not only in Ceylon but also in other countries, more particularly Malaya and South India. We shall commence with

the lectures given on these countries, and then go on to Mr. Wright's lecture on Rubber Cultivation generally.

Ceylon, be it noted, does not receive a special lecture, but the figures lately collected by Messrs. A. M. & J. Ferguson for the 1906 edition of their Handbook and Directory show that the Island now contains the surprising amount of 104,000 acres of rubber in the hands of European planters, and probably another 10,000 in native hands.

Mexico not being represented at the Exhibition, no lecture could be obtained upon it, but a recent report by Dr. Pehr Olsson-Seffer goes to show that that country contains no fewer than 20,000,000 trees, or an area of 100,000 acres at 200 trees to the acre. Probably this is an over estimate, and probably the trees are more closely planted, but in any case it will be fairly safe to credit the country with 60,000 acres.

Malaya Rubber.

By Mr. J. B. Carruthers.

At the Exhibition Pavilion Mr. J. B. Carruthers, Director of Agriculture, Federated Malay States, delivered a lecture on "Rubber in the Malay Peninsula." Dr. Willis presided, and there was a very fair attendance.

Mr. Carruthers, who was received with applause, said in the first place he must apologise for not having been able to place before them a well-balanced and carefully prepared paper such as they were fortunate enough to listen to from the various gentlemen who had lectured. His excuse was that, along with the other judges, his time had been fully occupied from the day he arrived at Peradeniya; and another excuse was that the generous hospitality he had experienced had rather prevented the serious consideration and study necessary. In talking of the rubber industry of the Federated Malay States they had, of course, to start with a very large country, and a larger proportion of that country was capable of growing rubber than was the case in Ceylon or any other tropical agricultural country. That was due to the fact that they had equable conditions over the whole peninsula. The Federated Malay States were about the size of Ireland, 26,300 square miles. That meant about 17 million acres, and he thought he could say without exaggeration that probably one-third of that area would grow profitably *Hevea brasiliensis*. He did not wish to frighten Ceylon planters with these figures, but at the same time they must allow that in the Federated Malay States they had very large areas, so that in the future they would be able to keep pace in competing with other

countries which were planting up Para rubber. Unfortunately for the rubber industry they had not. however, got a sufficient dense population to be able to draw on for labour for the rubber estates. The amount of land per head of the population in the Federated Malay States was 24·80, nearly 25 acres, while in Ceylon they had an average of $4\frac{1}{2}$ acres per head of the population, so that they would see they were more sparsely populated in the Federated Malay States than they were in Ceylon, and that was always a drawback to any industry in which a large amount of labour was employed.

With regard to the places already planted up with rubber. he directed attention to maps on the wall and pointed out Johore, which is not a protected State, and the four protected States, Selangor, Pahang, Perak, and Negri Sembilan. Selangor, he said, was the first place to have rubber planted, and as he thought planters were in some ways like a flock of sheep—they followed each other—the amount of rubber cultivated was rather greater than in the other States. The land there was really not very much better for the growth of Para rubber than in many other parts of the Federated Malay States, where there was equally good land. By the kindness of the Surveyors-General in the various States he had been able to hang up in the Exhibition maps showing the amount of land alienated for rubber up to June last in the Federated Malay States; and many of them interested had seen the large area marked red and green on the maps compared with the large quantity in Perak, and also the fairly large quantity in the Southern State of Negri Sembilan. He thought he was well advised in saying that in the Federated Malay States the Para tree grew with more vigour and vitality than it did in its native home in Brazil. The reason was that they had growing conditions practically all the year round. They had constant rainfall and a constant record of sunshine. The conditions for leaf production and root production and all the functions of the tree were present all the year round. They had dry periods, but these were not periods of drought, but only periods during which the rainfall was less than in any other parts of the year. It was an interesting fact that if they looked at the map of the world, the place which most closely approximated the antipodes of Brazil was a point (which he indicated on the map), and which he said was rather nearer the Federated Malay States than Ceylon.

He thought the Federated Malay States could grow much better rubber than was grown in its native jungles in Brazil. One of the features of that series of lectures had been the number of figures quoted. The figures he had had been published in his annual report, but it might interest them

if he just recapitulated, as far as he could recall them roughly, the figures up to 30th June last. Of course, as he mentioned in one of the previous conferences, the land alienated was entirely different from the land planted. Their rules for letting land were very simple. The whole of the land belonged to the Government. That gave them a stronger position from a political economy point of view than any other country in the world. Every acre belonged to the Government and was not sold on any pretext whatever. The land was leased in perpetuity, so that the land owner had practically all the advantages of a freehold. This was calculated to help in the opening up of the land in rubber. They charged for the first few years one dollar per acre per annum, and then when the rubber came into bearing in about seven years it was raised to three or four dollars. All the land was divided into two classes, and it was one of his duties to arrange for that classification, and during the last nine months he had had to examine more than 20,000 acres of land applied for, and alienated for rubber. The three or four dollars was fixed according to whether the land was first class value or whether it was near a centre or not. In the State of Pahang the terms for land were much easier, for the simple reason that no one had planted up rubber there, and they wished to attract people to open up the country and he thought pioneers should be better treated in this respect than those people who simply came in after the results that could be obtained were proved. There was some 55,000 acres planted, and very well planted, in the Federated Malay States, and they were trying to find out roughly what the acreages of different ages were. He thought they might take it that under one year old there were very nearly 25,000 acres of rubber, one year and under two years there were about 14,000 or 15,000 acres, under three years old there were 4,500 acres, and under four years 3,000 to 4,000, and under five years 8,500 acres—a total of 55,000 acres. In all, the land alienated was a very much larger figure—about 150,000 acres he thought probably by the end of June. That land had been leased to men who not only said they proposed to grow rubber on it, but were bound down by the conditions of their lease to open the land within a certain period of time. A quarter of the land must be opened in five years. That might not seem a large proportion, but there were reasons for not hustling. A man, if he took up a big lot of land, had to seriously begin to open it up.

He had mentioned the rainfall and sunshine as the reasons why they could grow rubber, and that was more marked when they looked into the question of soils. Mr. Bamber would tell them after examining samples that their soils in

SAMPLES OF RUBBER

the Federated Malay States were chemically of very poor value. He spoke subject to correction because he had not first-hand knowledge; but he thought very few of the soils in Ceylon, except worn-out estate soils, would not compete successfully with the average soil in Malaya on a chemical basis; but to discount that nearly all their soils were of a good physical character. That was to say their roots could get away freely, and rubber was a plant which, he thought it was pretty generally recognised, if it had plenty of rainfall and sufficient plant food to build up its tissues, would grow as quickly as on soil which was rich chemically. Then there were a great many plants which were economically cultivated on soils which were good physically, but bad chemically, and where the rainfall and sunshine were excellent. On the other hand, their soils varied very much, and he was surprised to find (in a place which he indicated on the map) in Lower Perak some very fine soil. The soil there was different from the friable and free soil of the Klang district, and was a stiff clayey soil. If they pushed their stick into it, when the stick was withdrawn it came out with a pop like the cork of a bottle. He had not heard of it being tried, but he thought it was a soil which would make excellent bricks. That was a soil, he thought, in which the root would get away easily. The proof of the pudding was, however, in the eating of it, and here they had rubber growing extremely well. They had some of the original trees growing there—the trees planted by Sir Hugh Low more than 20 years ago—17 or 18, which were growing enormously in this stiff land and therefore they came again to the point that this growth was largely due to the climate, and he was rather glad to think—without appearing to be too selfish—that in Ceylon, unless something very extraordinary occurred in the physics of the world, they could never get a growth as good as they had in the Federated Malay States.

He had a curve showing the average rainfall in the Federated Malay States. Of course, in some districts the rainfall was heavier, as for instance round Taiping, where mountains caught the rain, but, broadly speaking, the rainfall was about eighty inches a year, which was not a heavy rainfall compared with some Ceylon rubber districts, but they must remember that it did not come down in plumps and leave them to wait three months without having any more.

To drive the fact home as to the difference in growth in the Straits and Ceylon, he had two sections of trees which he had shown in the Exhibition. Both were grown in poor soil. Those who knew the Government stations in Ceylon knew that the soil was not up to the average, but below the

average, in composition, and then, of course, the climate was not so good for the growth of rubber when they had long droughts and further wet periods in some districts. One section was from a fourteen-year-old tree grown at a Government station in Ceylon in poor soil, and he had also a section of a fourteen-year-old tree grown in equally poor soil, even below the average of the Federated Malay States. The difference in girth was fairly marked. He believed, if he remembered rightly, that the Ceylon section was seventeen inches in diameter as compared with twenty-two or something like that. Anyhow, there was a quite sufficient difference to justify his statement that the trees grew quicker in the Federated Malay States. He had not time to go into the question of the rings of growth, but if they examined the tree grown in Malaya they would find two distinct rings, probably within twelve months, one, of course, showing the period of leaf-fall and the other probably showing the relatively dry season—two months, June and July—when they had only about five inches of rain. The Ceylon rings seem to be more regular in their width and curious periodicity. That was a question they might have to go into, and if Mr. Herbert Wright were there he might have been able to make some interesting remarks on it, as it was a question which he had studied very carefully. He did not know whether he had omitted any information of interest about the Malay States; if so, he hoped they would ask him questions on any points about which they wished to hear more; but he noticed that during the whole of these conferences everyone had carefully steered clear of the labour question, because, perhaps, it was too difficult to tackle. Even Mr. Ryan had not been brave enough to do so. He thought it was only fair to say that Malaya being a mining country, rates of pay must necessarily be higher than those they were fortunate enough to have in Ceylon. Still, their rates of pay were a long way off showing a serious discrepancy between the cost of production and the marketable rate of their produce.

In regard to the health and freedom from disease of their rubber trees in the Federated Malay States, he was in a position to judge, as he had spent ten or fifteen years of his life studying plant life in health and disease, and he would say, speaking roughly, from what he had seen of it, that the *Hevea brasiliensis* was a tree that possessed an abnormal amount of vigour compared with others. Tea, of course, was an extremely hardy and vigorous plant and tolerated all sorts of ill-treatment from fungi and insects and the ruthless knife of the pruner, and all other enemies; and he thought they might also congratulate

themselves upon the high standard of vigour and vitality of the Para rubber tree. It would certainly take a great deal before any disease would actually clear it out. At the same time, in the Federated Malay States they were not quite so well situated in regard to climate for disease-prevention work as Ceylon. There was no doubt that long drought was a great help, chiefly in the direction of preventing the spread of fungi, because during periods of great dryness the spores of the fungi would not germinate, and therefore they had, so to speak, a close time for fungi, and started fair again at the beginning, when most of the fungi had either been completely desiccated or, perhaps during a small rainfall, had started germinating and when the dryness came on had been killed. It had not been fully realized how, in relation to certain diseases, long periods of drought and long periods of wet had considerable preventive value. A great many diseases caused by insects, as he was sure had been the experience of many men in that room, spread until there was a heavy rainfall, when the conditions became inimicable to their spread, and the insects were driven away. So while their cloud in the Federated Malay States had a silver lining, or indeed the cloud was almost silver-plated all over, he congratulated them upon the fact that in Ceylon their drought and dry periods had some advantage in the prevention of disease.

He was rather sorry that at, perhaps, the most interesting lecture of the whole series, that by Mr. Green and Mr. Petch, held in the afternoon, for some reason or other there was only a small attendance of planters, though there were a large number of others present. He could not help thinking that some had an unbalanced way of looking at the industry, because one of the most important things that the rubber planter had to do was to look after and keep his trees in health and vigour, and he was trying to persuade the Malaya planters that each estate should be thoroughly equipped with plant for dealing with disease, so that, as no doubt Dr. Willis would bear him out was the case with his department, he would not be troubled by planters writing, saying that they had disease on their estates and asking how they were to deal with it, were they to get a spray, and so on; and while all this was being done the disease was spreading and perhaps had practically got out of hand. He thought nothing could be more important than to impress upon rubber planters that just as for valuable pictures in a gallery you keep fire buckets ready to prevent the pictures being destroyed by fire, so planters should have the proper appliances ready so that all that was possible could be done to check the

disease without having to rush about and perhaps to write to the central towns, where he believed these appliances were not always obtainable at once, though Ceylon was probably in a better position than the Straits in that respect.

Another point might interest them. It had interested him very much, and that was the question of helping the market. It seemed to him that day of prosperity and of splendid prices, when some of them were making large sums of money, was the time to dig out plans for future prosperity. They might look round to see in what direction they could help the consumption of rubber. One direction they had been greatly interested in was the question of rubber pavement for roadways. As they were aware, rubber pavements had been laid down. One of these was under the archway leading to Euston station, where a rubber pavement was put down in 1881. It was two inches thick, and the General Manager of the London and North-Western Railway had given some particulars as to the experiment. In May, 1902, the pavement was found to have worn down to $\frac{5}{8}$ of an inch in the thinnest places. He had there a sample of the rubber laid down in 1902, and it was by no means pure rubber. One would not be far wrong in saying that there was not much more than ten per cent. of pure rubber in it. He found out roughly from a London County Council official when he was at home the cost of wood and asphalt pavement, and, speaking roughly, this rubber pavement cost something under three times as much as wood or asphalt, but the life of wood or asphalt was four years, and here they saw that the life of a rubber pavement was twenty years, so it was a simple arithmetical sum to find out from the point of business that the cheapest article was the rubber, and he could not help thinking that some of the wealthy rubber-producers might be well advised if they attempted to approach the authorities in London or some other big countries and even present them with sufficient rubber to put down, say, 300 yards or 400 yards of pavement. He had estimated roughly the amount of rubber which would have to be used for paving the whole of the London streets, which were at present paved with wood and asphalt, assuming the material to be of the same quality as the sample he had there, containing say, ten per cent. of pure rubber. It would require nearly as much rubber as a whole year's consumption for all other purposes, and it therefore did not require to be driven home that if such use of rubber could be brought about in London—and the other big towns would follow—they would find their prices, instead of, as they all expected now, going back, might go forward and even the halcyon days of 10s. a pound might be reached.

In one of those conferences Professor Dunstan's remarks were mentioned in regard to the future possibilities of synthetic rubber, and His Excellency the Governor also mentioned the subject in his speech at the dinner given to the judges and delegates. He thought a wrong impression had gone about as to what Professor Dunstan, who was one of our greatest authorities on economic chemical questions, said. The British Association met at York and they had not met there before for twenty-five years. What Professor Dunstan said was :—

"Moreover, it cannot be doubted that chemical science will sooner or later be able to take a definite step towards the production of rubber by artificial means.

"The production of caoutchouc by chemical means has, indeed, virtually been accomplished in its formation from isoprene. The exact nature of this change has still to be determined. When this has been done it will only remain to cheapen the cost of production to make the manufacture of synthetic rubber a purely practical problem. I should be the last to discourage the great extension of rubber planting which is now taking place. It is warranted by the present demand for the material. It has also to be remembered that the actual cost of producing raw rubber, which is at present about one shilling per pound, will probably be reduced, and the market price of rubber may eventually be so considerably lowered that, as with quinine, the synthetic production could not be profitably carried on. That is a question which involves many factors at present unknown, and only time can decide. Chemists may, however, confidently predict that before the British Association again meets at York the synthetic production of rubber will be a fully accomplished fact.

"As I have said, our science is concerned with nearly every problem connected with the great rubber industry, and in concluding these few remarks I may allude to the production of vulcanised rubber depending on the formation of additive compounds of the hydrocarbon with sulphur.

"In this connection I should mention the recent experiments of Mr. Bamber in Ceylon, which appear to show that vulcanisation may be accomplished by acting on the uncoagulated latex. If this proves to be practicable, it may mean the transference to the tropics of the subsidiary industry of vulcanisation, which is at present carried on in Europe."

Therefore the speech which had so disquieted many fearsome folk merely stated that the question of synthetic rubber might be solved before the Association met again at York. He did not think a statement of that character would make their

flesh creep, for twenty-five years was a long period, and no one knew what was going to happen by that time; but he thought the impression had gone about, as he had noticed from various remarks that had been made, that the manufacture of synthetic rubber was a thing of the near future.

The Discussion.

The CHAIRMAN, in inviting discussion, remarked that they had listened to a most interesting lecture.

Mr. W. D. GIBBON said he was much interested in hearing of the Malay States, because 8 or 9 years ago he had visited the Federated Malay States. At that time he might say the planters were in very low water. Their Liberian coffee was fetching prices hardly large enough to meet the expenses, and everything then was gold and tin. Rubber was then put in as a sort of refuge for the destitute. He saw then alongside of the railway between Klang and Kuala Lumpur very promising rubber plants. They far exceeded in size anything they had then attempted in Ceylon. They in Ceylon or the States then thought there was nothing to be made out of rubber. Proceeding, Mr. Gibbon recalled the hard times the planters then passed through, and said that the boom in rubber in the Straits was an illustration of how times changed. The Straits were now booming, and men were going home to end their days happily. He trusted rubber would do the same for many of them in Ceylon.

Mr. ZACHARIAS pointed out that the maps of the different States were not on the same scale and might be misleading. He might mention that in Negri Sembilan and Selangor they had some very fine estates, in fact, one exhibit of smoked rubber from Selangor at the Singapore Show was an extremely excellent one, and he was sorry the gentleman did not send it here. In the Siamese Malay States, in Kelantan and Kedah, areas had been taken up for rubber cultivation, but the tenure of land was absolutely insecure under the native Rajahs, and, although they might get a concession to-day, they did not know whether it might not be revoked to-morrow. Then there was Johore; they did not know what it would do in the future. Sir John Anderson anticipated great trouble owing to labour. There were also the small islands on the coast, which were under Dutch jurisdiction; so, on the whole, if they thought of going to the Malay Peninsula, he thought they would do well to go to them in the Federated Malay States.

The Annual Rings : White Ants.

Mr. Ryan : I should like to ask Mr. Carruthers a couple of questions about, first of all, the rubber trees that he has shown us, as to how he accounts for the difference in the annual rings in the two sections. Of course, we all know that these rings are not necessarily annual, but the tree from the Straits has twenty-eight of them, whereas the Ceylon one has only fourteen. The other point I wish to ask a question about is this. In Klang, especially as you get nearer the mouth of the river, there is a great deal of water, some of it tidal water, at a short distance below the surface, and I noticed attacks of white ants generally beginning at the tap-roots. In fact, a very large number of the trees had no tap roots at all and the remedy applied when I was there in many instances was to bore a tunnel under the tree supported entirely on its lateral roots, and put in various chemical mixures. It has occurred to me since I have come back that possibly the white ants came after the tap root was diseased.

Mr. Carruthers : Mr. Ryan takes us into rather deep waters by his question as regards the rings, as he says the rings are not necessarily periods of twelve months. We are rather apt to translate rings by our previous experience in temperate climates in which winter occurs, and there is a cessation of growth which, of course, means a ring on the tree. I am not sure that Mr. Ryan's figures of 14 and 28 are absolutely correct. I think one wants to go very carefully over the lines before you can tell at what periods cessation of growth has occurred. I think it is an extremely interesting point as to how to account for the difference in rings, and I hope, perhaps at the next conference, some one may be able to read us a paper which will elucidate this matter. In regard to white ants, I believe the way to attack white ants is by carbon-bisulphide, and Mr. Kelway Bamber has an ingenious appliance for this, and I hope before the Exhibition is over he will be able to show us this machine at work. It is one of the many things I wanted to see, and if it works and produces carbon-bisulphide, as Mr. Bamber has every reason to believe it does, I think we shall have got a sound solution of the way to fight white ants, which are a serious enemy, but one which, I think, we shall manage to exterminate if we take it in the right way.

Mr. Proudlock : Were the sections of both trees from the same height above the ground—because that would make a difference ?

Mr. Carruthers : They were both cut one foot from the ground. Knowing the suspicious nature of the planters of

Ceylon, I must ask them to remember my five years of comparative honesty when I was in Ceylon and to accept it from me that both trees were fourteen years old, and the other circumstances were as similar as possible.

Mr. Petch: The Government plantation that the Ceylon section was taken from is planted ten by ten. I should like to know the distance of the planting from which your section was taken.

Mr. Carruthers: I think that is a fair hit. The other trees were not so near together. (Laughter, and hear, hear.)

Mr. Petch said white ants in Ceylon never attacked the tree unless it has been attacked by fungus. but the man who had done most work in connection with white ants found that in the Straits there was a species of white ants which would attack living trees.

Mr. Smith asked, with regard to the question of annual rings, whether there was anything in periodicities of temperature or rainfall which accounted for them, or whether it was observed in the growth of rubber trees that growth took place in two vigorous bursts at a particular time of the year, which would probably account for two rings per year instead of one.

Mr. Carruthers said he thought Mr. Smith was right in his translation of these rings. One was for the leaf fall. As he had said, they had no periods of drought. They had periods when the rainfall was less than at other times, and he thought it was highly probable, if worked out carefully, they would find that the rings on the Selangor section are one ring for leaf fall and one ring for June and July, in which there is a relative cessation of growth.

Straits Soils.

Mr. Bamber said he would like to say a few words about the Straits soils, of which he had analysed a number. Mr. Carruthers' remark that they were exceedingly poor was practically correct, but he had seen soils there which were as rich as anything he had analysed anywhere. The area was, however, limited. Looking at the Malay States map they would see down the coast a line with deposits in places of sand and in places of mud, and generally inside where the mud was deposited the soil was richer than where the sand was deposited. There was only a limited area in which they had rich soil, however, and he quite agreed with Mr. Carruthers when he said their inland soil was as poor as their Ceylon soils. While rich in nitrogenous matter it was, as a general rule, deficient in potash, but that did not seem to affect the growth of the trees at all. It was a point he had tried to make out in Ceylon that the physical condition for the rubber and tea tree was

equally important, if not more so, than the chemical condition, and for that reason he had urged the cultivation of Ceylon soils to improve the physical condition, for owing to the heavy and constant rainfall they had got to such a state that in many instances it had become impossible for the air to penetrate into the soil at all, and it was quite as essential for the air to get to the roots as to the leaves, and unless they allowed the air to get at the roots they could not get good results. In conclusion, Mr. Bamber described his machine for exterminating white ants.

Dr. Lehmann observed, in regard to Mr. Bamber's remarks as to the soil, that the preservation of organic matter was of great importance, especially in the tropics. It was a subject which he had given considerable attention to in Mysore, where coffee required a loose soil and a soil of good mechanical condition, just as he believed the rubber tree required. In addition to what Mr. Bamber pointed out, they must have a lot of organic constituents in the soil as well.

Mr. Bamber said he quite agreed with Dr. Lehmann as to the importance of preserving or replacing the organic matter in the soil. He merely said that it was necessary that they should improve the physical condition of the soil and admit air to the roots, and on that account he strongly advocated cultivation of the soil in Ceylon. His experience of many thousands of acres in Ceylon cultivated year by year, or possibly once in two years, was that even where no manure had been applied there had been great improvement, though he had quite realised that merely forking the soil was not enough. He had been advocating the growth of Crotalaria and other means of supplying organic matter.

Mr. Gibbon said that as an old planter he would like to say he considered they had much more leaf on the ground now than they had in the days of coffee. Dr. Lehmann had perhaps not travelled over the planting districts yet sufficiently to make himself acquainted with the conditions, but he thought he would find they had a great number of Grevilleas planted all over their estates, as well as other trees, which gave them a great deal more leaf than they ever had in the time of coffee.

Mr. Brabazon said he took it from Dr. Lehmann's remarks that he recommended mulching throughout the estate, which prevented wash and protected the soil?

Dr. Lehmann indicated that this was so.

Straits Labour Recruiting.

Mr. J. B. Coles said he thought it would be very interesting if one of the Straits planters would tell them under what conditions they recruited labour from Southern India.

Mr. P. W. Parkinson said that they recruited their labour through Government licenses. The Government helped them to a great extent in assisted passages, so that when they came to divide up the coolies among a number of estates the passage did not run into very much. Labour had undoubtedly been a great trouble owing to the crimping of coolies that at first went on for all public works. If they wanted labour now, they sent up for a Government license, and a man was licensed to recruit a number of coolies. He took it to Negapatam where it was registered. The Madura Company were their agents. He was given 20 or 25 dollars before he left, and when he brought the coolies to Negapatam he got 4 or 5 dollars advances per head for them. The Madura Company telegraphed to the people in the Straits, and they had the coolies met at Port Swettenham. The cooly cost them about 15 or 16 dollars, which was all recovered. The superintendents all noted exactly how the coolies stood, and in a great many cases the coolies' advances were in the check rolls. It meant a great deal of extra work to carry forward these advances, but it meant they were in personal touch with their labour, which was a great advantage. (Applause.) In his own instance he had a great many coolies on his estate who were all recruited by coolies who asked for licenses to go and bring their friends, and it looked as if they were going to remain there permanently. Their rate of pay in the F. M. S., which was a mining country, was somewhat higher than in Ceylon, being 27 cents of a Straits dollar. The cooly rice cost him one and a half dollar, and his rice stuffs another dollar, so that at the end of the month the cooly had 4 or 5 dollars to play with or pay back his advances.

Mr. Brabazon : Might I ask Mr. Parkinson what he means by an assisted passage ?

Mr. Parkinson said that Government granted the planters 4,500 tickets, and these tickets were divided up on an acreage basis, and a cooly coming over by one of those tickets cost the estate only about $2\frac{1}{2}$ dollars instead of 15 dollars by the usual way. As far as he could see, the coolies did not seem to appreciate these tickets very much, and in a great many instances they came as readily without an assisted passage.

Dr. Willis proposed a hearty vote of thanks to the lecturer, which was cordially given.

Rubber in South India.

By Mr. E. G. Windle.

The subject of Saturday morning's lecture was "Rubber in South India," and it was delivered by Mr. E. G. Windle. Dr. Willis presided.

Mr. WINDLE said : When Dr. Willis paid me the compliment of asking me to say something about Rubber in South India, he did not, I am sure, expect me to make any attempt to teach experts like yourselves anything new in the growth and treatment of rubber, but merely to report progress in the cultivation with observations on our somewhat different conditions, and this I will endeavour to do. Southern India is, as you are aware, considerably behind Ceylon in rubber cultivation, owing to various causes. Ceylon had the benefit of getting the original plants ordered by the Indian Government, and, from the first, far more attention was paid by the Ceylon authorities to growing and distributing seed and plants, so that, when planters turned seriously to rubber cultivation, Ceylon had a large supply of seed bearers and consequently great facilities for rapid extension. Here also planters are in more immediate touch with civilisation and its wants than is the comparatively isolated Indian planter in his widely scattered districts, and Ceylon men are, if I may say so, more accustomed to rapid introductions of a new staple than are their conservative Indian brothers. In Southern India many of us who were planting some 25 years ago tried our ‘prentice’ hands on Ceara rubber, generally at elevations varying from 2,500 to 4,000 feet. It grew well, as a rule, but was a disappointment when young as a rubber producer, this being, as I can see now, partly due to our absolute ignorance of how to tap. It was certainly fatal to coffee if tried as a shade tree, and all idea of its being profitable was abandoned.

There was also an attempt by a few Wynaad planters about that time to plant Para, Castilloa, and Landolphia, with other tropical products, below the Western Ghauts in Malabar, but this attempt collapsed after about a year, mainly, I believe, on account of the title to the land being defective. From that time until some eight years ago nothing more was done that I am aware of, but in 1898 one planter, Mr. A. G. Nicholson, began to plant rubber amongst his coffee, getting Para and Castilloa seeds from South America, Ceylon, and the old trees in the Nilgiri Government Gardens at Burliar. The price of seed deterred others as a rule, though, personally I got a few Para seeds from the Straits through the kind assistance of the Hon. Mr. G. S. Forbes, of the Madras Government, and have now some seven-year-old trees growing at 3,600 feet on the Anamalai Hills. In the succeeding years no one but Mr. Nicholson planted rubber on any scale, but as the price of seed became more reasonable about 1902, a slight movement towards rubber planting began. In 1903 some good-sized areas were opened and since then planting has been extending fast. I should put 1904 as the year in

which, with the exceptions mentioned, Southern India really began its serious planting of rubber. As to areas open at the present time I have done my best to collect some figures on the point, and I am fairly certain that they are not under the mark.

	Acres.
The Nilgiris and South Wynaad	1,200 mostly in coffee. Para chiefly.
Malabar and South Wynaad ..	400 Para, Castilloa, and Ceara
Coimbatore ..	1,100 Para.
Cochin ..	1,000 Para.
Travancore ..	6,000 Para.
Shevaroy Hills ..	1,200 mostly Para in coffee.
Pulnies ..	100
Mysore ..	—
Coorg ..	2,000 chiefly Ceara.

The total amounts to 13,000 acres, of which 4,000 are coffee, planted with rubber, and at least 8,000 acres are one and two years old. Tapping has been going on with old Cearas in various places and very good prices have been obtained. I lately saw an invoice showing 6*s.* per lb. for biscuits from South Wynaad, and a small lot of smoke-cured from Coorg was valued at 5*s.* 9*d.* Para from Mr. Nicholson's 5, 6, and 7 years old trees on the Shevaroys at 3,500 feet has sold at 6*s.* in London. Castilloa, so far, I have no prices of in any bulk. Some surprise, if not incredulity, was expressed in Ceylon at the results I gave in the *Madras Mail* of March 14 this year, from tapping some of Mr. Nicholson's Paras at 3,500 feet, but it must always be borne in mind that though Ceylon is more nearly under the equator than we are in India, our climate is not an island one and is considerably hotter than that of Ceylon at similar elevations. Our nearest approach to your climate is on the west coast of India and the hills facing in that direction, but, even there, the heat is considerably greater, and I would be inclined to put the temperature at 3,500 feet in South India as corresponding with that at about 2,200 to 2,500 feet in Ceylon. A few days before I left India I was talking to a Nilgiri planter about Para which he had growing at 4,000 feet. He told me that a shade temperature of 93 degrees had just been registered, and, as we have been having a fairly steady monsoon, it seemed noteworthy. I know of healthy, though slow-growing, Para at over 5,000 feet on the Nilgiris, though I should certainly not think it worth any one's while to plant rubber at such an elevation simply as rubber, yet, as a shade for coffee, with the prospect of some possible future value, it is on another footing.

Castilloa also seems to do coffee no harm, though from its shape and growth it is not so well adapted for shade as Para. With rubber planted under such varying conditions as it is in South India, there is naturally great difference in the growth, but there is no doubt that Para is a remarkably hardy and adaptable plant, and, though it may do best under ideal conditions, it will do well in widely varying ones. For ideal conditions I would have good, free soil at nearly sea level, sheltered land with just enough slope to drain well, and a rainfall well distributed of 80 to 120 inches. But in South India we see Para yielding a paying quality of high class rubber at 3,500 feet, in a stiff soil, with a rainfall of 45 inches. I have seen very good growth with a rainfall of 230 and 250 inches, and, though it is noticeable how both too little and too much rain practically stop the growth, the plants seem to make up for this subsequently to a great extent. Except in certain parts of South India, we may say that at least three months will be dry, or with a rainfall during that time in an average year of under an inch per month. In some parts in a year of drought, I have known this dry season extended to five months, and, according to our old ideas of rubber, this would make the planting of it in such places useless. But I can say, with confidence, that Para is at any rate hardier than coffee, for instance, in standing drought. I have seen coffee planted with Para of the same age, with its leaves small, shrivelled, and hanging straight down at the end of a long drought, whilst the Para looked quite healthy, though there were few of the young shoots which are so noticeable in growing weather, and I should mention that the coffee was no worse than in neighbouring fields containing no Para, so that the latter was not apparently robbing the coffee in any way. During the dry season of this year in Cochin I noticed that the rubber grew steadily throughout, and from observations in many other places I should say that, provided the soil is deep and free, the growth of Para is not interfered with during a normal Indian dry season, and that it is an open point whether it does not benefit by it. I noticed in the *Times of Ceylon*, 4th May, 1906, the mention of what was called "a notable case" in point. "In a clearing of tea and rubber exposed to a three months' drought it was the tea that faded away whilst the rubber plants grew amazingly." I think I may say that tea in Indian soil would scorn to "fade away" under a three-months' drought, but the growth of Para during the drought confirms what I have noticed in the drier districts in South India. When the soil is stiff the effect of prolonged dry weather is more apparent, and the plant almost stops growth, but does not, so far as I have seen, suffer otherwise

if once well established. An important point is the influence of dry weather on the yield. During the latter part of an exceptional drought on the Shevaroy Hills, which is one of our driest districts, the latex got steadily thicker until it almost ceased to flow unless drip tins were used—the tree no doubt utilising most of the water which the latex would normally contain—and the amount of rubber obtained consequently was small. The trees, however, showed no sign of suffering, and I imagine that it is a simple matter to arrange the tapping for the year so that the tree will not be touched, say from March to June, if necessary. Mr. Proudlock, Curator of the Government Botanic Gardens, Nilgiris, has noted the same thing with Castilloa, and I quote from his 1905 report :—

"During the drier months of the year, unless the Castilloa trees are irrigated prior to being tapped, the latex does not flow so freely as it does after a spell of wet weather."

As to yield : so far the only Para or Castilloa trees old enough to have been systematically tapped, so far as I know, are those in the Government teak plantations of Nilambur, at 250 feet elevation, a tree or two in the Nilgiri Government Gardens at Burliar, on the Coonoor Ghat, and a group of trees in a private garden at Calicut. None of these, however, have been tapped for yield, though $10\frac{1}{2}$ oz. have been obtained at one tapping from the old Castilloa tree, age about 25 years, at Burliar, at some 3,500 feet, and Mr. Proudlock considers that 2 lb. would be a very safe estimate for an annual yield of his oldest trees of either variety at that elevation. Mr. Nicholson's young trees, on Hawthorn estate, tapped for the first time this year, are giving good crops of seed, and are also being very lightly tapped, so that in the present infant stage of the industry in South India I cannot give you very definite information. A group of ninety-one trees of Para, on Hawthorn estate, according to the figures I gave in the *Madras Mail* on March 14th, 1906, had averaged $\frac{1}{4}$ lb. dry rubber each after a month's tapping, the trees being five, six, and seven years old from seed at 3,500 feet tapped in dry hot weather by inexperienced hands. The tapping was stopped for some time and has been only lately resumed, so that I cannot say anything further about these trees except that they are in excellent health. The yield from old Cearas seems fair ; 400 trees at 3,000 feet in South Wynaad, tapped by coolies with little supervision, gave $168\frac{3}{4}$ lb. dry rubber in two tappings, and the owner, a careful and reliable planter, considers a pound per tree a fair estimate. In the course of a another year tapping will be more systematic and will commence, I believe, on some exclusively rubber clearings such

as those of the Periyar Co. in Travancore. From what I have seen I have no doubt of the results being successful.

The yield from young Castilloa, seven years old and under, has not been found easy to deal with, the rubber frequently being resinous and sticky. From experiments conducted by Mr. Proudlock, Curator of the Government Gardens, Nilgiris, the great point appears to be careful washing, and I have seen rubber of good quality from even four-year-old trees prepared by Mr. Proudlock, much superior to that from well-grown seven-year-old ones, taken by coolies in the ordinary way. Last month I tapped half a dozen seven-year-old Para trees, planted amongst coffee to commence with, on the Anamalai Hills at 3,600 feet, and got small amounts of good rubber from each tree; I hoped to prepare some biscuits from these trees to bring over with me on this occasion, but all labour was taken up with planting. As to growth, from all I have seen I would say that the growth of Para when planted amongst old coffee is so much handicapped—and it must be recollected that even in non-borer districts nearly all coffee is planted up with various kinds of shades—that it is at seven years quite three years behind rubber planted in open clearings, in other words a seven-year-old tree in old coffee will not be better than a four-year-old one in the open. At high elevations, I have not the slightest doubt that any shade is a great hindrance to rubber development, except in the case of young plants just planted, and I believe this to hold good even at sea-level, though I know that a contrary opinion is held by some. Heat and light are two things that rubber cannot have too much of, as long as it gets sufficient moisture. Mr. A. G. Nicholson tells me that many young Paras rot in heavy (rainy) weather from being under shade. I have noticed this myself this season, and also that shade of any kind has a great effect in retarding growth. To return to actual figures, the measurements of some of the best trees on the Shevaroys at 3,500 feet, grown with coffee of the same age and other shade, from seed in 1898 at 3 feet from the ground are—

Para.	ft.	in.	Castilloa same age and condition.	ft.	in.
No. 1	1	6	No. 1	2	6
No. 2	1	6	No. 2	2	6
No. 3	1	7	No. 3	2	7
No. 4	1	10	No. 4	2	8
No. 5	1	8	No. 5	2	9

Heights were generally good; I give girth as being the most important measurement.

On the Anamalais at 3,600 feet the only Para of a similar age was planted amongst old coffee to commence with, and was, therefore, under far more unfavourable conditions; the best is 1 foot 7 inches. But in a rubber *clearing* on the Anamalais, four years old, the best trees are already 1 foot 6 inches in girth and average growth is very good, so much so that I fully expect this district to take the lead as far as high-grown rubber is concerned. It may be interesting to note in connection with this growth that the Anamalai forest is larger and finer than anything I have seen elsewhere. Castilloa does not do well there, the rainfall, some 135 inches, being too heavy. In Wynaad at an elevation of 2,300 feet to 3,300 feet, roughly, the rainfall ranges from 65 inches to 250 inches, Para has only been planted during the last two years, and on a smaller scale. The only figures I have are from South Wynaad, where sixty-two two-year old plants, measured in the clearing as they came, averaged 7 feet high; this was at 2,700 feet with heavy rainfall; the best was 12 feet 9 inches by 4 inches girth. Castilloa does well in the drier parts of South-east Wynaad with a rainfall of 60 inches to 70 inches. Ceara grows well, but those with old trees do not seem to care to extend its cultivation. Coorg and Mysore I have been able to learn little about. In South Coorg, Ceara has been chiefly planted in 2,000 acres open, North Coorg having as yet very little, and in Mysore terms for rubber land were only settled by the Government in August. In Travancore at 700 feet, rainfall 250 inches, Mr. Drummond Deane has kindly given me the following figures for his good trees:—Para one-year old, girth $4\frac{1}{4}$ inches; two-year old girth $8\frac{3}{4}$ inches, average 7 inches, Castilloa two years 16 inches, average 12 inches. I should like to have had figures of growth from Periyar or Rani with their four-year old rubber. Periyar, which I have seen, struck me as excellent growth. In Cochin there is nothing over one-year old. Growth is very fine, but I have not measured the trees, although I think these equal to the best above-mentioned. So far as we have gone in South India I should say that Castilloa is more particular than Para in its requirements, and is more difficult to tap, whilst it is also behind Para in giving good rubber at a similar age. I know, however, a Castilloa at 3,700 feet fifteen years old, girthing 50 inches, which has little or no appreciable resin and gives excellent rubber without trouble.

Pests.

So far there is little special to say. In most parts it is necessary to fence rubber against its large enemies, such as deer of all sorts, cattle, pigs, porcupines, &c., and a certain

amount of damage is done by crickets and beetles. Mr. H. Drummond Deane tells me that he has lately found a large white beetle with black spots, something over $1\frac{1}{2}$ inch long, which he sent to Mr. Herbert Wright. It attacks young trees at some 3 to 4 feet from the ground, making small punctures which start decay upwards. Below the puncture the wood is healthy and puts out new shoots. Mr. Deane also noticed a small beetle which damages one-year-old plants, but the total loss by both kinds of beetles was small. Rubber land is undoubtedly difficult to obtain, and by rubber land I mean that most suitable for rubber, giving good, tappable trees in five years' time. The Madras Government so far has declined to open forest reserves to the would-be rubber planter. The Travancore Government seems unable to decide upon a policy, and the Cochin Government refuses to consider applications for forest for the present, so that practically suitable land at really low elevations is only obtainable from petty chiefs and private owners. The Mysore Government has lately agreed to make grants up to 500 acres, on reasonable terms, of land on the Mysore plateau, say between 2,000 feet to 3,000 feet, Mysore planters being given the preference, but rubber cannot of course, be expected to mature as early there as it does in the plains, however otherwise good the conditions may be. I should like to say one word as to an idea that is common in India that small seed (Para) is not as good as large. In Mr. Proudlock's report for 1905 on the Burliar and Kellar Gardens I notice that in the one experiment mentioned in his tables where small seed had been used, the resulting plant was absolutely the best in girth of its year, and I have myself noticed that germination from small seed is at least as good as that from large.

Thickness of Bark.

As far as I have seen there is no difference in this at varying elevations with fairly similar rainfalls, though where the rainfall is heavy, bark is appreciably thicker, and, as I think is usual, bark on unshaded trees is thicker than it is when the trees are under shade. Southern India undoubtedly possesses great advantages in her unapproachable cheap labour, and in properly selected situations, her fertile soil, so that, though we have started late in the race for rubber, there is, to those who know the country, no reason to fear that it will not be able to fully hold its own in the world's market.

The Discussion.

Dr. Willis: Ladies and Gentlemen,—We want, in these discussions, to get to the bottom of everything, and as I see several South India representatives here to-day we will allow

them to speak first before the discussion becomes miscellaneous. I see Mr. Proudlock, whose name we have heard mentioned several times during the lecture, and Dr. Lehmann from Mysore, Mr. Cameron from Mysore, and, I think, one or two others. I should like to ask them to supplement what Mr. Windle has told us by giving us a little information on rubber in their respective states.

Growth and Yield of Ceara.

Mr. Cameron (Bangalore): For the past 15 years I have been growing Ceara rubber on a small scale in Mysore, chiefly in connection with the Botanic Gardens there. Of course Ceara, as far as I know from my own experience, is likely to do better in what we call the dry zones in Mysore. Mr. Windle's remarks seemed to refer more to the hill regions than the maidan of Mysore, where Ceara really grows as a weed. The trees, after 5 or 6 years, begin to seed freely, and you find where they are growing in clumps the seedlings come up with the first monsoon very rapidly, in fact so rapidly that they become a nuisance, and we pull them up and throw them away. This, however, is not the point. During the 15 years we have been growing Ceara there it has been found that for the first 7 years there is comparatively little latex in the tree, and then as we go on to 12 and 15 years some of them have a great deal of latex, while others seem to have comparatively little. That is my experience, and it seems to show that there are varieties of the Ceara tree, which give more latex than others. This, I think, has been established in Mysore. With regard to trees, we have trees 6 feet from the ground, 4 feet in circumference, and I think 45 feet in height—I have not taken the actual measurement. The good varieties of these trees, when tapped carefully, would give 3, 4, and 5 lb. of rubber without injuring the tree. One tree which we tapped very severely with the object of finding out how much it would give, gave 7 lb. It was collected in the form of scrap, and we wound it up in balls and sent it to brokers, and they at once valued it at 3*s*. per lb. I should say, therefore, to attain the best results on plants in Mysore it would be necessary to let them attain the necessary age. I do not think much good can be done by tapping at 5 or 7 years of age, but tapping after 10 or 12 years ought to be very productive. With regard to Para trees, we can grow seedlings very readily, but we cannot grow the trees.

Mr. Carruthers. Hear, hear!

Mr. Cameron: I can grow you lakhs of seedlings to a height of some feet, but our first dry season kills the whole of the seedlings. That is due to the extreme dryness of the air. In

the months of March, April, and May it is exceedingly dry. With great care and by putting tubs of water on the ground I have managed to grow some to the height of 3 feet, but that was all. Castilloa grows to 15 or 20 feet with us, and no doubt much higher in other parts of the State. The latest experience of that tree is that it grows better in the open than in the shade even with this extreme dryness. I am of opinion that Castilloa in Mysore will form an excellent shade for coffee. There they require a shade denser than in the Nilgiris, and I think, on that account, Castilloa will prove equally good as a shade tree as Para has done on the Nilgiris.

Dr. LEHMANN : I should like to make clear what may cause a misunderstanding, in regard to the extraordinary dryness of Mysore. The general climate of Mysore is one which varies to great extremes. We have in some places 300 inches of rainfall dropping down to very few in the extreme eastern portion of the plateau, and Mr. Cameron's remark in regard to the effect of the dryness of the Para rubber seedlings applies to the locality of Bangalore where Mr. Cameron has been growing quite a number of rubber trees in the Botanic Gardens. In the planting districts of Mysore, where there is a comparatively high rainfall, Para rubber will grow fairly well. I have had comparatively little experience with Para. I have seen them growing here and there under shade, but they did not flourish as well as they ought; but I think Mr. Cameron will admit his remarks with regard to dryness and the seedlings dying applies to the Bangalore district, and not to the province as a whole.

Mr. CAMERON : I think the dryness, Dr. Lehmann, practically affects the whole maidan of Mysore. It does not affect the hill regions. I think the hills are very dry during March, April, May, and the beginning of June.

Dr. LEHMANN : It does not affect the planting districts ?

Mr. CAMERON : No.

THE LABOUR QUESTION.

Mr. JAMES RYAN : Before we go I think there is one question that interests us all, and that is how labour conditions are likely to affect rubber. It is a matter in which we are apt to come into rivalry, and we would like to smooth the path for it.

Mr. WINDLE : The question of labour conditions is rather a delicate one. At the same time my own private opinion is there is enough labour for us all. Personally I can say that when I came out to India, 31 years ago, we paid four annas a day to the ordinary cooly and we are paying about the same amount now and the advances have not gone up. I think if

you extend your operations a little more to the north and north-east than you are doing now, you will find that the labour supply will increase just as fast as you can increase your rubber. There is any amount of labour ready for us all, and I don't think you will interfere with us. I think that not only Ceylon, but other countries, might draw from it without the rates going up.

Mr. HERBERT WRIGHT: With reference to Mr. Windle's remark on the cultivation and growth of coffee and rubber, I should particularly like to know the distances apart at which the rubber—Para, Castilloa, or Ceara, whichever kind, or when all or either of them are planted—has to be planted in order to allow the coffee to remain as a permanent product. In most cases close planting of rubber would kill out our tea, and I should like to know at the elevation to which Mr. Windle referred the distances which have been adopted for rubber without diminishing the other crop.

Mr. WINDLE: That is a matter we have not proved satisfactorily for ourselves. To compare rubber in coffee with other shade I would compare it with the ordinary grevilleas. We plant grevilleas amongst the coffee every fourth, fifth, or sixth row, according to the individual idea of the planter. The coffee is planted six by six, and you can calculate for yourselves what that may be. I think we might plant rubber at the same distances, and if we found it too close, I know some planters have thinned it out in the same way as any other shade. I have seen Castilloa planted in the same way, but when young it gives a larger shade, and it might have to be planted wider apart.

Mr. WRIGHT: With reference to what Mr. Windle said on the subject of yields at 3,500 feet, I understand these results were obtained with Para rubber. I should like to know in association with that the age of those trees, and the method of tapping. I think the yield was ¼ lb. per tree per month.

Mr. WINDLE: The ages were five, six, and seven years, and of the latter there were very few trees. The first planting, made only for shade, was only 1,000, and a considerable number were killed.

Mr. WRIGHT: And the circumference of those remaining five, six, or seven years that were tapped?

Mr. WINDLE: I think I gave you the circumference—18, 19, and I believe up to 20 inches.

Mr. WRIGHT: An average of twenty inches?

Mr. WINDLE: Not quite so much as twenty. The method was spiral tapping

Mr. WRIGHT: And you got ¼ lb. in one month?

Mr. WINDLE: Yes. I shall be happy to show them to any of you if you come over.

Elevation and Climate.

Dr. Willis said with regard to the climate at the same elevations in India and Ceylon, he could bear out what Mr. Windle had said from his own experience. Take the case of Bangalore, where he saw coconut plantations growing comfortably at 3,000 feet to 3,500, whereas in Ceylon we regarded 2,500 as the limit where coconuts would grow. Again, outside Calcutta, when the weather was so cold that he wanted three blankets at night, he saw coconuts growing forty or fifty miles up the river. Throughout India it was generally recognized, by botanists at any rate, that the hot summer seemed to make more difference than a cold winter, provided there was no serious cold or frost, and things would grow at higher elevations in South India, and even up in North India, than in Ceylon. In comparing with Ceylon they ought to allow at least 1,000 feet in elevation.

Mr. Ryan said he could bear that out. They might remember that a few weeks ago Mr. Fairhurst, from Foochow, told them that in Foochow they had a winter of fairly continuous frost, and they occasionally had even had snow, but they had very hot summers. A Para tree which had been accidently planted in the garden of one of the compounds there, quite close to the bungalow, was twelve years old and was a foot in diameter—not circumference.

Mr. Carruthers : One of the many things that interested me in the lecture was the information that six months drought in South India did not mean a cessation of growth in the tree.

Mr. Windle : I did not go quite as far as six months.

Mr. Carruthers : I think you said up to five months, and you had evidence that it did not mean the cessation of the growth of the tree. It is, of course, a difficult thing to see from external signs exactly what is going on inside the tree, but it would interest me to know what sort of data you had to make you think you did not get almost a cessation of growth in exact ratio to the drought you have each year. It is especially interesting to me because in our climate we have practically no cessation of growth except with the dropping of leaves, and we were pleased to think we were in a happy position in relation to South India and a good many parts of Ceylon. I should like to know exactly what the data were.

Mr. Windle : I did not say five months' drought does not affect the growth. I say the ordinary dry season—we might put it at three months during which we have drought, *i.e.*, three months with less than an inch per month rain—in a season like that as far as we have seen, the plants are practically not

affected. Taking one of the hottest places I know—Cochin—which is practically at sea level. I have in my mind a place about 50 feet above sea level, during this hot weather we have passed through, which I may mention was unusually hot and prolonged, I noticed Para trees growing, as I have no doubt they do here, in regular jumps. The tree would make a shoot and give out a spread of small leaves. These would develop and the plant would make another shoot, and so on. That continued throughout the season.

Mr. CARRUTHERS: That is very interesting.

Mr. CAMERON: You speak of the Para tree as deciduous, or is it evergreen?

Mr. WINDLE: I would call the Para rubber tree a deciduous tree to a great extent. It sheds a great many leaves, and it seems to have a season of its own.

Mr. G. H. KRUMBIEGEL: With reference to Mr. Ryan's remark in regard to the Para that he had found growing in a cold climate where there was frost and cold, I think it may interest you to know that I have tried Para for many years in Baroda at sea level and have found in all cases, during the cold weather when the temperature goes down to 42°, all the trees have died. Thinking that in the hot weather the hot winds would be a drawback, I had them protected and kept moist. We think dry weather is also against Para. In regard to Ceara our trees are four years old, and are doing exceedingly well. I have tapped but very few, but latex flows well, and I have every reason to believe that they will be successful. I think if we can get better information about growing them as an annual crop, success in the plains of India will be secured. I am trying to grow them as an annual crop. During the monsoon they form an enormous growth.

Dr. WILLIS said he did not think people quite realized that—he noticed that in connection with a good many cultivations in Ceylon—the dampness of the air had almost as much effect as the rainfall. We were accustomed to regard Mannar as a dry district because it had only 35 inches of rain a year, while Kandy was wet because it had 81, but they must remember that Mannar had a damper air than Kandy, as he had mentioned the previous day. The percentage of saturation in Mannar was 82 and in Kandy 78. In other places in what was called wet Ceylon the percentage was lower still. He did not say Mannar was as damp as Kandy, but the dryness of the air had a considerable effect. In Kandy the lowest degree of saturation was rarely below 61 per cent. In Bangalore it went down to 50 or even lower, and in North India lower than that. At Lahore it went down to 30 and even below. The effect of dryness was mainly shown by evaporation from the leaves.

and that depended upon the dryness of the air. It did not matter if there was no rain at all if the air was saturated; the trees would go on fairly comfortably.

Mr. RYAN: The coconuts Dr. Willis saw north of Calcutta would probably do very poorly in a climate like Ceylon, and *vice versa*.

Dr. WILLIS: My point, of course, was that the coconuts will grow in a climate so cold that if one felt that temperature here one would look for strawberries and things like that. When I was in Calcutta the night temperature was down to 42 and 48 degrees, and in Ceylon it is admitted the coconut will not grow where the temperature goes below 55. They have a very hot summer in Calcutta with a temperature of 102 to 105, and they have a cold winter. They had the same kind of compounds in Calcutta as in Ceylon, and thousands of coconut trees may be seen growing there. One might think they were driving out from Colombo if it were not for the dryness of the fields.

LARGE AND SMALL SEEDS.

Mr. RYAN: Another point raised by Mr. Cameron was interesting, and that was the question of seed selection. We all know in other departments of botany there are certain trees which are better than their brethren, and in cotton, for example, Dr. Willis showed us yesterday how by careful selection twenty-five per cent. or more can be added to the price. In rubber I think it is a most important matter, and if some of our friends who have seed from trees which are giving yields of repute would preserve that seed carefully, I am perfectly certain that I for one would be prepared to pay a largely enhanced rate for them. It is a case of like father like son, and seed from a good tree will, especially if it is properly fertilized by pollen from another tree of equal merit, give results superior to anything you could get from the rank and file of seed. Another point is the germination of small seed. In regard to that we have our tea experience to guide us. In tea small seed will very often give as good a plant as large, the only difference being that there is a larger amount of nutriment available in the large to carry on the life of the plant. The quality depends on its parentage, not on the size of the seed. On the other hand, if it has to live under poor conditions the good supply of albumen in the large seed will possibly in some instances carry it on rather longer than if it started with a deficient supply of nutriment. I think, further, that very frequently seed which is not quite ripe will germinate faster than really ripe seed. Whether this depends on the fact that unripe seed has more water Dr. Willis may tell us. In

Botanical Gardens you will find among individual plants a small percentage which are infinitely superior to their neighbours. I have myself in grevilleas and gum trees, of which I have planted many thousands, two of these trees showing five to six times the girth and height of the rest, although the seed was planted from the same batch. In both instances the large trees are on poor soil, showing that there were no special conditions to account for this further than the fact that we occasionally get very large members of the human race, while in the same family you may have a dwarf. These things are flukes, and by careful selection the fluke can be perpetuated and the dwarfs eliminated.

Mr. Proudlock : I should like to ask Mr. Windle what he said about small seed. I did not quite hear him.

Mr. Windle : I mentioned that in a table given in your last report one tree-measurement you gave was from small seed. It was mentioned so in the report, and that particular tree gave very excellent measurements, rather better than those of its fellows of the same year. That struck me as very interesting, as I also found that small seed does very well.

Mr. Proudlock : I think Mr. Windle's remark must have related to Para rubber which was planted in Kullar Gardens. I have planted one line 30 feet apart, and I have obtained the seed from different parts of India and Ceylon and also from the Straits, and I simply planted them with the description received with them.

Mr. Windle : Perhaps Mr. Proudlock will tell us if he has noticed any difference between large and small seed as far as the vigour of the plant goes ?

Mr. Proudlock : I have not found any difference with regard to the yield obtained from large seeds and small seeds respectively, but I have found trees varying much in their yield of rubber. For instance, in February, 1902, when I had to tap trees in the Government Plantation in the Wynaad, there were many hundred trees of a tappable size, and out of that number only one gave us an exceptionally high yield, 13 3/16 oz., of dry rubber at one tapping. I have saved the seed of that tree, and we are cultivating that variety now, and we sell the seed to planters at Rs. 8 without difficulty—in fact the demand is greater than the available supply. The seed of the ordinary trees we cannot sell even at Rs. 2-8 annas. I think there is a good deal of value in Mr. Cameron's remarks on that point of cultivating those trees which give an exceptionally high yield of rubber. You will also see there the progeny of another high-yielding variety I have in Kullar is promising to give excellent yield of rubber. We have two varieties at 2,400 ft. elevation and also at Kullar at 1,400, both

of which are doing extremely well. We have tapped occasionally but not heavily within the last 2 years, and they give promise of doing as well as their parents.

Mr. Ryan : Is Mr. Proudlock talking of Ceara ?

Mr. Proudlock : Yes ; all Ceara there.

Dr. Willis said they had so many millions of seed now that it was time to talk of this. They found in tapping experiments at Henaratgoda many years ago that the yield from the different trees of the same variety varied enormously. They had now enough trees to go on with tapping experiments, and he was beginning to think it was time for them to fell the trees immediately surrounding those giving a good yield, so that we may be able with some certainty to get the best of those left for the propagation of fancy varieties. They had hitherto to sell all their seed, and their trees were growing closely crowded together. It was only now becoming possible to fell those of poor yield and leave those of extra good yield standing.

Mr. Ryan : You must remember we have had warnings in the past. We have been ruined in coffee and cinchona by planting seed from diseased trees—poor seed—deteriorated seed of the third and fourth generation.

Mr. Carruthers said he had now got a fairly large nursery about a year old of selected seed. Dr. Willis's remarks regarding the felling of the trees sounded somewhat drastic. He did not go so far as that. He went on the system of putting bags on the fruit before they were ripe, so that when the fruit burst it fell inside the bag and there was no danger of their gathering seed from other trees. He did not in selecting go according to the quantity of latex, because he did not know what the trees were giving, but he went by the vegetating vigour which was often a very good guarantee of the latex. He felt perhaps a little pleased to hear that that should be done, and that they in the Straits had got a year ahead of Ceylon.

Mr. F. C. Roles : What material did you use for the bags ?

Mr. Carruthers : They were paper bags.

Dr. Willis said he was not merely dealing with coolies picking seed from under the trees, but the prevention of cross fertilization with the inferior trees left standing. Of course, their good trees at Henaratgoda, which yielded a very large quantity of seed, were very old, and that seed in large quantities comparatively speaking would be ready for immediate sale should it be proved by experiment that the quality of latex yielded was hereditary. That, of course, they did not know except what they heard from Mr. Proudlock, but there was every reason to believe from their knowledge of heredity in

every kind of animal and vegetable life that that was the case At any rate some such effect would be caused. There was a very much better chance of the progeny of a good rubber tree being good than the progeny of a bad rubber tree being good.

This concluded the proceedings.

The Cultivation of Rubber Trees.

By Mr. HERBERT WRIGHT.

THE lecture by Mr. Herbert Wright on rubber was delivered in the refreshment pavilion. His Excellency the Governor presided and took part in the discussion.

Mr. WRIGHT said :—The almost impossible task of giving a comprehensive lecture, under a time-limit of twenty minutes, on the subject of the cultivation of rubber trees, has fallen to my lot, and we cannot do better than briefly survey, in a very general manner, the chief features of the rubber industry as presented to us to-day. It is a wide subject, and consideration of the hundreds of samples of rubber prepared on these and adjacent shores, or of the implements and machinery used in collecting and coagulating latex, curing rubber, and many other matters, must be held over for other occasions. The first point we have to consider is that of the selection of rubber trees for cultivation. We are often told that the present boom in rubber in Ceylon, the Federated Malay States, the Straits, Java, Borneo, and India, &c., is only a forecast of disaster, and that we are engaging ourselves in a cultivation which, though lucrative enough while maximum market values obtain, will prove unremunerative when large acreages come into bearing, when substitutes and synthetic rubber gain a better footing, and when diseases begin to spread. We are reminded, often by very earnest men, that our cultivated rubber trees are not indigenous in the East, and we have been assured that sooner or later the histories of coffee and cinchona will therefore be repeated ; these assertions, if correct. should be received with more serious consideration than at present. In the first case, however, I am permitted to point out that we are preparing to combat diseases when they arise. and after thirty years' experience, on somewhat small plantations in Ceylon and the Straits, no difficulties have been observed except those which can be overcome. The plea that we cannot succeed with our rubber trees because they are not indigenous is not well-founded : we cultivate cacao as successfully in Ceylon as others do in Central and South America or the West Indies, where it is said to be indigenous ; our tea compares favourably with that in Indian and other districts

where it occurs wild, and our oil cultivations will stand a comparative investigation. The greater number of the past and present planting industries of Ceylon are the outcome of the cultivation of species which do not occur here in the wild state; the indigenous plants capable of being regularly and largely cultivated in Ceylon are very few and are typified in our cinnamon.

With reasonable confidence do we therefore look forward to the cultivation of many species introduced from other countries, and among them must now rank those from which rubber is obtainable. The question as to which is the best species to adopt in cultivation is one which is frequently raised, and with this we can now deal. The species which has been vigorously planted in the East is *Hevea brasiliensis*, and in view of the present importance of this species in the plantation rubber industry we might well ask: Have we or have we not selected an inferior type? Are we, after all, on the wrong track? Are we extending this particular cultivation too much and neglecting others? Thanks to the energy of all concerned, and especially to competitors in this Exhibition, these questions can be answered fairly satisfactorily. The extension in the cultivation of Para or *Hevea* rubber has been steady and, except for the last few years, slow, and has been influenced by the results obtained during twenty years of patient waiting and working; we have not based our anticipations simply on a single experiment with a single species, but rather on a wide knowledge of the real value of many rubber-producing plants. We have our Ceara rubber trees (*Manihot Glaziovii*) scattered throughout Ceylon, from the dry hot districts of the North, East, and West to the damp and cooler areas in the South; we have had them for over twenty years at altitudes varying from sea-level to over 4,000 feet, and visitors from other climes assure us that the growth obtained in Ceylon is as good as that in Tropical America. Similarly Castilloa (*Castilloa elastica*) has been cultivated in districts with different climates, Gutta Rambong (*Ficus elastica*), *Landolphia*, and *Funtumia elastica* are also known in Ceylon, and plants of the Sapium, Palaquium (Guttapercha), and Balata (*Mimusops Balata*) have also been tried. The literature of the tropical world has enabled us to learn something about the value of Root Rubbers, the Guayule (*Parthenium argentatum*), *Urceola*, and several climbing and herbaceous plants; our judgment is therefore not based on fanciful or passing rumours. The opinion of most persons vitally concerned in the rubber industry in Ceylon is that where Para rubber will grow it can be cultivated as the mainstay of the estate. Even to-day we learn that in some districts the

coconut palms and trees of Gutta Rambong are being felled to make room for Para rubber trees.

Para rubber trees grow rapidly; they yield rubber of high quality, they have proved to be very hardy, and we are convinced that they will stand the ordinary tapping operations to a remarkable extent. The rate of growth and present immunity from pests of *Hevea brasiliensis* put it, in Ceylon, above *Funtumia*; its yield places it on an equal or even higher plane than the best *Castilloas* from Panama or Mexico, and its hardy characteristics and response to the extensive use of the ordinary tapping knife render it superior to *Ceara* and other rubbers. Each species of rubber tree may thrive in particular districts, and, when we can give more time to them, better results may be obtained in Ceylon with other kinds, but the verdict to-day is that Para rubber, as far as we can judge, holds its own in every way: in growth, hardiness, and yielding capacity. The confidence in this species is not confined to the Indo-Malayan region, but has spread to many islands and territories throughout the tropical zone. Africa—or at least the West Coast of that vast continent—with its numerous rubber-yielding indigenous plants, will take as many seeds of *Hevea brasiliensis* as we can give, because it has been found to be superior to others native in that area; and even this year thousands of seeds, for planting purposes, have been sent to Brazil, the country whence all our rubber seeds were obtained in 1876. We have the assurance of a visitor with African experience that *Hevea brasiliensis* beats most of the rubbers with which he is acquainted, and many persons must feel compelled to agree with that conclusion.

Knowing then, as we now do, how the Para and other rubber plants have flourished in the East, it is our next duty to inquire into the available details regarding the commercial value of the produce, the methods of extraction, and the yields obtainable. What do we know regarding the comparative commercial values of the various kinds of rubber? It is true that most of the plantation rubber is valued at the present time according to appearance or physical properties, though most of the wild rubber is appraised by people who, from experience in the manufacture of rubber goods in the factories, know the proportion of essential ingredients in the raw rubber they handle. The home manufacturers are undoubtedly becoming aware of the possibilities in plantation rubber, and though—often for very good reasons—they have looked askance at several consignments, the day must come when, from constancy in chemical composition and physical properties and from the constancy in purity and output, the rubber from cultivated areas will receive their very serious

attention. During the last few years the output of wild rubber from several countries has been difficult to accurately forecast, and speculation has naturally followed such a condition of affairs; the sources of plantation rubber on the other hand will ultimately be well known, and safer calculations of the probable output will be possible. This constancy in output and a guarantee of quality, grade, &c., possible when dealing with well-managed plantations, will arrest attention in the near future.

Though our plantation rubber, as at present prepared, may or may not have the best physical properties, we are certain of one thing, and that is that we have selected forms which in contradistinction to others may be described as pure types. The three forms—Para, Castilloa, and Ceara—yield rubber possessing a high percentage of caoutchouc, the component on which the real value largely depends, and on account of which the synthetic chemists are working so perseveringly with hope of success. Our Para rubber, prepared even in the ordinary way, possesses from 90 to 95 per cent. of caoutchouc, and some samples of Ceara and Castilloa rubbers have from 76 to 90 per cent. Though many of the other rubbers may, when prepared by proper methods, show a higher percentage of caoutchouc than they do at the present time, it is doubtful whether they will ever exceed, by any appreciable amount, the 95 per cent. of caoutchouc which has been proved to occur in some samples from *Hevea brasiliensis* and other species. Of course, there are other useful ingredients in rubber, and many believe that the proportion of caoutchouc can be reduced with advantage. Undoubtedly, the physical properties and the appearance of the plantation rubber can and will be changed in course of time; we know the nature of the processes by which means wild rubber is said to acquire some of the physical properties which manufacturers consider desirable. The production of rubber on the same principles—evaporation and use of antiseptics—as obtains in the Brazilian forests is capable of being carried out in Ceylon, Federated Malay States, the Straits, and India not only as effectively, but at less expense, and the producer in the tropics is only waiting for the unanimous order from the manufacturers to begin work on those lines. We have been assured by Professor Dunstan, at the meeting of the British Association just concluded at York, that the physical properties of raw rubber, on which its technical value depends, are to be correlated with the chemical composition of the material itself, and we are told that the elastic caoutchouc substance in each of the finest rubbers is of a similar nature. We already know that there are high percentages of caoutchouc and favourable

proportions of other ingredients in our plantation rubber, satisfactory yields are obtainable, and most of the trees, especially of *Hevea brasiliensis*, appear to stand tapping operations even when of a very drastic nature.

Methods of Extracting Rubber.

We have, curiously enough, mainly confined ourselves to extracting latex by methods of tapping which obviate the destruction of the tree. But it is well known that there are plants such as the Mexican shrub (Guayule) which can be grown quickly, uprooted, and the latex from the whole of the substance extracted by a process of maceration and washing; I would suggest that the Landolphias, root rubbers, and other plants might be similarly dealt with, and good yields of rubber obtained therefrom.

It would be a fortunate discovery if some herbaceous plant capable of cultivation in the East as a subsidiary rubber crop in a clearing of Para, Castilloa, or Ceara rubber could be found. We have now secured the machinery to extract rubber from dead bark tissues, and it has been questioned, in connection with some of our arborescent plants, whether the rubber obtainable at the end of the fourth or fifth year by felling or lopping the tree and macerating the bark is not worthy of consideration. The idea may appear fanciful and even absurd for trees of Para rubber, but it is of considerable interest in connection with the prunings and bark, &c., of Ceara rubber, or of plants which cannot stand tapping. We may subsequently find that we are in the beginning of a new era in the extraction of rubber from some tree forms by methods other than tapping.

Comparison of Plantation Yields in 1905.

Be the growth or methods of cultivation and extraction what they may, the features on which the prosperity of our new cultivation largely rests are the yields obtainable and the period over which such can be guaranteed. It is certainly too early to make a definite statement on this subject, but it is fairly safe to say that good and most promising yields have been obtained from trees of Para rubber. An annual yield of one pound of dry rubber per tree is, perhaps, above the average for mature Ceara rubber trees, and many have even questioned whether such an amount can be obtained from Castilloa trees of a fair size and age, whether in the East or West. Para, Ceara, and Castilloa can be planted at approximately the same distance apart, so that the yield per tree affords a fairly reliable basis for a comparison of their relative values.

The whole of the results which have been obtained up to date in Ceylon, Federated Malay States, the Straits, and India are not available, but it is interesting to find that in 1905—our first genuine year of working with Para or Hevea rubber trees—we obtained, according to the only figures in my possession, in Ceylon from 138,655 trees, 189,743 lb. of rubber; the Straits obtained from a certain 58,860 trees, approximately, 57,000 lb. of rubber (these figures do not, of course, give the total quantities of rubber exported from or relative yields in these countries), and specimens in Africa and India show a promised yield of from ½ to over 1 lb. of rubber per tree. To put it briefly, an average yield of about 1 to 1½ lb. per tree has been obtained from nearly 198,000 trees, at a time when the methods of extraction were novelties and our knowledge of a scanty range.

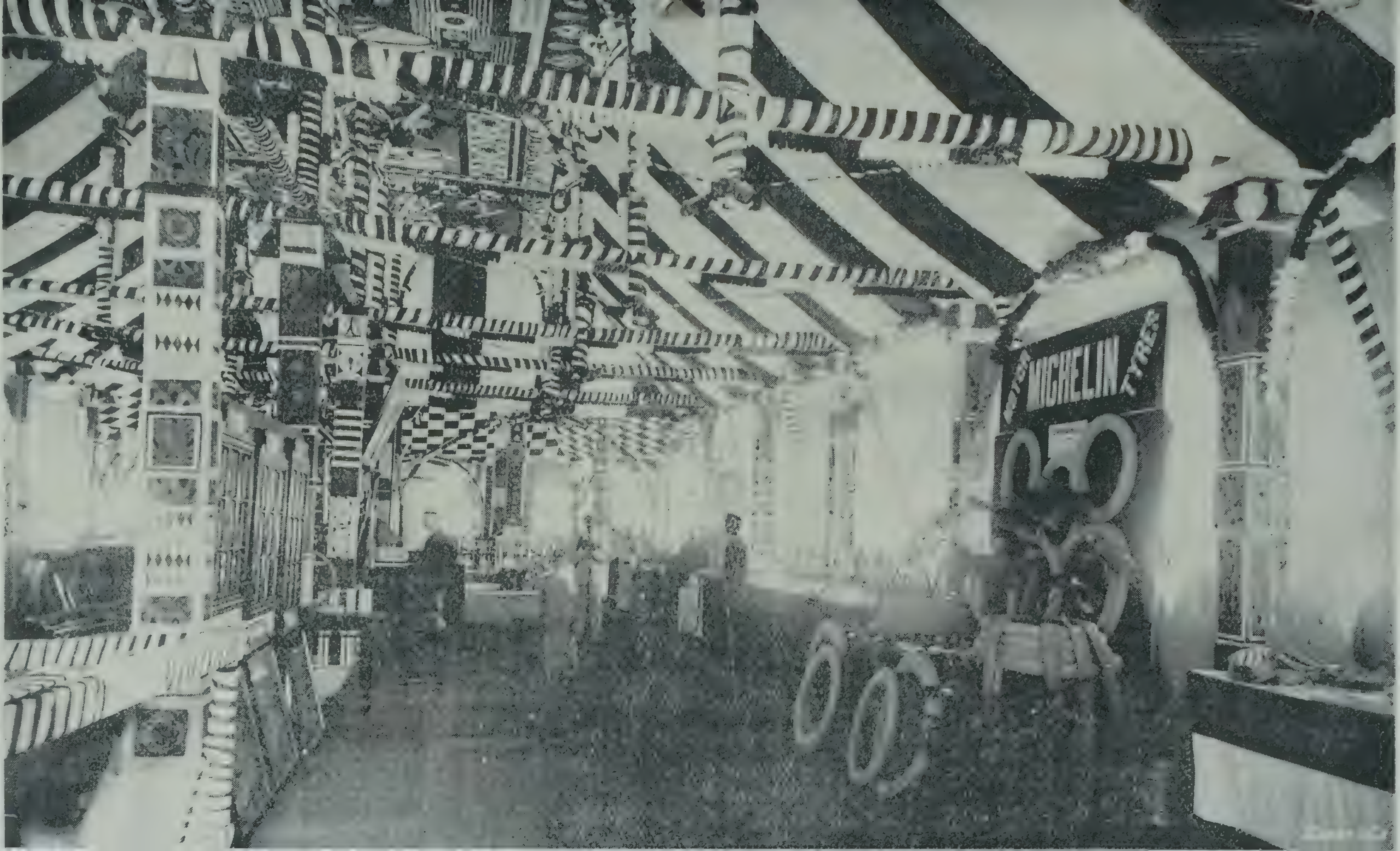
Results for several years in succession are available from the Henaratgoda Gardens. In the old days, when the trees were lightly tapped only every second year on an antiquated system, a yield of 1½ lb. per tree was obtained per year for a period of nine years. That was from a tree which, when first tapped, was about fifty inches in circumference and approximately twelve years old. Since then various experiments have been made on the Henaratgoda trees, and a yield of from ten ounces to 15 lb. of dry rubber per tree has been obtained in less than twelve months, by methods which will certainly not kill the tree under four years. Some old and apparently dead tree stumps of Para rubber appear to be still keen on yielding latex, though they have not produced a single leaf during the last three years. Estates in Ceylon are known where an average annual yield of ¾ to 3 lb. of rubber per tree, for a few years in succession, has been obtained.

As has been previously explained, the bark is the "mother of rubber;" the adoption of better systems of tapping, which obviate the necessity of paring away the tissues wherein the milk accumulates and drawing supplies of latex by merely cutting and not excising the laticiferous tissues, is bound to result in an increased yield, since the life of the tapping area is so much prolonged. The fact that a few well-developed trees have been made to give as much as 12 to 25 lb. of rubber per year, and promise abundant yields in the very near future, shows what a tremendous amount of material there is to draw upon, providing the environs of the plant and tapping operations are fully understood. Ten years hence we shall probably smile when we look back upon the methods we employed in the collecting of latex and preparation of rubber therefrom, in the year 1906, or when we reflect

on the satisfaction with which we viewed our crude ideas and forecasts in the memorable year of the first Ceylon Rubber Exhibition. However, we are not only willing but anxious to forget what little we know at the present time of anything which will improve our future prospects. While rubber cultivation is in its infancy it will be as well to consider the probable effect, in a comparative way, of its prolonged cultivation. The effect of growing rubber trees is—especially with species which, like *Hevea*, *Castilloa*, and *Ceara*, annually shed all their leaves—to be compared with that of a deciduous forest vegetation; the chemical investigations made at Henaratgoda show that the soil may be improved in certain directions by growing *Hevea* trees for a period of twenty-nine years. If the rubber trees are grown in association with a permanent intercrop of cacao, or more or less transient crop of coffee, tea, cotton, camphor, &c., the conditions are quite changed, and many results are obviously possible. But when the extraction of the product from rubber trees is considered, one can see that the removal of the latex and nothing more, necessitates very little exhaustion to the soil. Compared with tea, and even with coconuts or cacao, the soil exhaustion following the removal of two pounds of latex per tree per year appears small. Unfortunately, however, we have not arrived at that stage of perfection when the latex can be extracted by the simple incision of the laticiferous tubes, and it is only possible to compare present methods of bark excision with those meted out to cinchona in the past.

Rubber Land available in the Tropics.

Comparing the past with the present, the planters in the tropics can already profit considerably. In the old days Para rubber was planted mainly along streams or the banks of rivers, near sea-level, but to-day we know that, though in the Straits the cultivation appears to limit itself to places at a low altitude, in Ceylon it can be grown successfully and rubber of good value be obtained from trees at an elevation of 2,000 feet and even at nearly 3,000 feet above sea-level in districts with a high temperature and poor rainfall. In Southern India even 3,000 feet is not accepted as the maximum elevation at which *Hevea brasiliensis* can be slowly but successfully grown. Furthermore, our experience of the growth of rubber plants in soils of different kinds has taught us that in addition to alluvial banks there are soils which, though they are perhaps of a poorer type, give satisfactory results, and to-day even swampy patches, which have never been known to be capable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of yielding paying crops before, are now growing excellent rubber trees; swamps should, of course, be well drained and otherwise properly treated. The climatic or soil conditions under which it has been proved that rubber plants can be successfully cultivated in Ceylon, the Straits, and India, have aroused the interest of almost every institution in the tropical world, and it would be idle to even wildly guess at the thousands of acres which could now be made to grow rubber in the Malay Archipelago, Ceylon, the West Indies, Africa, and parts of South and Central America. Rubber cultivation is now rapidly developing into a science, better work is being done in planting operations, more care is being exercised in eradicating pests as soon as they appear, and admirable skill is being displayed by the producers in their efforts to place on the world's market the best quality of rubber they can.

The Other Side.

My remarks to you to-day may be regarded as very optimistic, but it would be difficult to be otherwise in the face of the work accomplished and the immediate prospects before us. There are gloomy aspects to every industry, but those associated with rubber cultivation are no more serious than those which face the tea, cacao, coconut, and other industries on which this and other countries have largely developed. We are told that our back pages are full of unpleasant possibilities; we have to face the contention that, though the consumption of rubber will probably increase at a more rapid rate when prices are easier, yet at the same time the plantation supply promises to increase at a rate which is sometimes alarming, and which, together with the impetus given to the collection of wild rubbers in African and Tropical American territories, may have an effect not in accordance with our desires. The planting of a quarter million acres of rubber plants in a small fraction of the Indo-Malayan region alone, within a few years, shows what can be done, and our activity is not likely to be ignored in other parts of the world where rubber plants can be grown.

When one reflects on the land already yielding or alienated for rubber in the East, and considers its potentialities in relation to last year's consumption of, let us say, 60,000 tons of rubber and a future yearly increase of about 5,000 tons per year, it is with surprise that one realizes that there is a limit to the extension in this particular cultivation. Consider for a moment what 60,000 tons of wild rubber (equal to 48,000

tons of pure rubber) represent; assuming that, on an estate, each tree yields only $\frac{3}{4}$ lb. of rubber per year, and that there are 150 trees to an acre, you have a means of providing one ton of pure rubber from every twenty acres of land. Yet, about 60,000 tons of wild rubber were gathered last year, a yield which will probably not diminish for many years, and one which is the equivalent of 48,000 tons of pure plantation rubber or about nine hundred and sixty thousand (960,000) acres of cultivated land. One quarter million acres of cultivated rubber land, on this modest basis of 150 trees per acre, and each tree yielding only $\frac{3}{4}$ lb. of rubber, will give us 12,500 tons of rubber per year in, say, five, six, or seven years from now; it is therefore only necessary to quadruple the present plantation rubber area *in the Indo-Malayan region alone* to subsequently supply the equivalent of the whole of last year's consumed rubber. If you allow, as you may reasonably do, that the yield from cultivated rubber trees will be $1\frac{1}{2}$ lb. per tree, or 2 cwt. per acre, your future extension is further reduced. Dr. Willis has already given you a warning based on an estimate of about 200 lb. of rubber per acre per year.

Take up another position and imagine that in a few years from now the annual consumption of wild rubber will be about 100,000 tons (say equal to 80,000 tons of pure rubber). What acreage of rubber plants would be required to secure such an amount? How much of the required acreage have you already got? A demand of 100,000 tons of wild rubber per year can be met by the produce from 1,600,000 cultivated acres; already wild sources, calculated on the above basis, supply the equivalent of 960,000 cultivated acres; the Indo-Malayan region alone has alienated 250,000 acres, thus leaving much less than another half million acres to be opened by ourselves, and by others—there are others, please remember—in Africa, South America, Central America, West Indies, &c., as a reference to recent concessions, each of thousands of square miles, indicates. One may reasonably imagine that others, outside our little eastern circle, have possibly already secured the balance of land to satisfy this demand. I have taken the opportunity to discuss these figures with judges and others at this Exhibition, and have given them, perchance they may be of interest. I am by no means wedded to these figures if anyone else can produce a better or more reliable series.

Let the consumption for 1905 be 60,000 tons of wild rubber, equivalent to 960,000 cultivated acres (60,000 tons wild equalling approximately 48,000 tons plantation). Let the

rubber acreage in the Indo-Malayan region for 1906 be 250,000 acres.

Distance of trees apart.	Trees per acre. (Approx.)	Yield of rubber per tree, per annum.	Approximate yield per acre, per annum.	Yield of pure rubber from 250,000 acres (Approximate).
20 × 15 ft. ..	150	$\frac{3}{4}$ lb.	1 cwt.	12,500 tons.
,, ..	150	$1\frac{1}{2}$,,	2 ,,	25,000 ,,
,, ..	150	3 ,,	4 ,,	50,000 ,,
15 × 15 ft. ..	200	3 ,,	5.3 ,,	66,200 ,,

198,000 young and old trees in Ceylon and the Straits gave in 1905 about 240,000 lb. of rubber.

10,000 trees in Ceylon, average age about 10 years, gave 30,000 lb. of rubber in 1905.

Let the demand be 65,000 tons of wild rubber in 1906. For argument's sake let the demand increase at the rate of 5,000 tons of wild rubber per year; 5,000 tons of wild rubber equal 4,000 tons of plantation rubber, allowing the difference in impurities to be approximately 20 per cent. Let the supply from wild sources remain constant at 60,000 tons per year. Then what cultivated acreage will be required, assuming that each tree gives only $\frac{3}{4}$ lb. of rubber and each acre has only 150 trees ? :—

Year.	Demand for Rubber.	Wild Sources.	Balance of wild rubber required.	Cultivated acreage required to supply balance. (Approx.)
	Tons.	Tons.	Tons.	Acres.
1906 ..	65,000 ..	60,000 ..	5,000 ..	80,000
1907 ..	70,000 ..	60,000 ..	10,000 ..	160,000
1908 ..	75,000 ..	60,000 ..	15,000 ..	240,000
1909 ..	80,000 ..	60,000 ..	20,000 ..	320,000
1910 ..	85,000 ..	60,000 ..	25,000 ..	400,000
1911 ..	90,000 ..	60,000 ..	30,000 ..	480,000
1912 ..	95,000 ..	60,000 ..	35,000 ..	560,000
1913 ..	100,000 ..	60,000 ..	40,000 ..	640,000
1914 ..	105,000 ..	60,000 ..	45,000 ..	720,000
1915 ..	110,000 ..	60,000 ..	50,000 ..	800,000
1916 ..	115,000 ..	60,000 ..	55,000 ..	880,000
1917 ..	120,000 ..	60,000 ..	60,000 ..	960,000

It should be remembered that the 250,000 acres planted in the East in 1906 will not really be giving any rubber much before 1912, and that in that interval prices may vary considerably, more systematic methods will probably be adopted in the collection of wild rubber, new areas exploited, and many extensions and improvements made in all parts of the tropics. If the increase in consumption is much more rapid, and substitutes are used in proportions similar to those of to-day, then the prospect for the cultivation in the tropics is probably considerably brighter. The whole subject is very complicated, and I would earnestly ask this audience, in view of the rapid extension of rubber cultivation in many parts of the world, to seriously consider a few of the figures presented to-day. These figures are only given to attract attention to this part of the subject, and I hope others will compile their own series and see what conclusion can be arrived at.

But this is neither the day nor the place for considering the gloomy side, and I gladly leave it to you to reflect on the operations necessary to keep diseases in check, to supply the labour of the future for tapping your recently planted trees, and to consider how high prices, substitutes, and artificial rubber are going to affect your otherwise pleasant prospects. The rubber trees which have been selected for cultivation willingly yield a satisfactory quantity of latex, and I imagine, though I may be quite wrong, that your earliest difficulty will probably be that of procuring the labour necessary to take full advantage of even the quarter million acres already alienated for or in rubber.

The Discussion.

The Exhaustion of Soil.

Mr. Bamber: Your Excellency and Gentlemen,—Mr. Wright has referred to the exhaustion of the soils by the growth of Para rubber, and I should like to point out that the actual sale of the rubber takes practically nothing out of the soil; but at the same time the growth of so many trees largely planted among tea is rapidly exhausting the surface soil of available matter. We are able to replace it very largely by ordinary manurial methods, but at the same time we have not been able to replace that organic matter which is essential for preserving the necessary moisture for an easy flow of latex. I noticed at the Government Plantations at Yatipauwa, where the soil is very poor and of a kabuk character, that the trees, in order to obtain the organic matter, sent their roots along the surface and up into the dead stump of a tree, actually replacing the wood of the same by the roots of the

tree growing up in the air. I think we ought to do more to try and increase the humus matter in the soil if we are going to continue a free flow of latex in the future. Mr. Wright referred to the fall of the leaf, which certainly replaces to a large extent the manurial and organic matter, but one must remember that there is a very large amount stored up, and the Hevea being a surface feeder more or less the exhaustion is rapid. Mr. Wright, in his calculation, was referring to trees planted 15 by 20. I myself think that ought to be the minimum distance at which rubber should be planted. The actual growth of the roots far exceeds what is calculated—a foot per year—and in 3 or 4 years roots may extend 15 or 20 feet, and the roots of many trees planted 15 by 20 have already crossed and passed each other, forming a lace work. It remains to be seen how far you can cut these roots in order to apply the necessary manure without interfering with the flow of latex in the trees. I think that for that reason alone the greatest care should be taken not to go in for too close planting. Coming here in the train yesterday I noticed rubber planted 8 feet by 8 feet. It seems to me that this is absolutely throwing money away.

The soil in Ceylon, though we have some good soil, is not particularly rich, especially in the low-country, and we have to remember that large areas have been more or less exhausted by the growing of tea; but as regards the actual loss from the manufacture and sale of rubber, it is practically *nil*. It is a question whether something can be done with the waste waters, but as far as I can see there is very little loss even if this were thrown away and not replaced in the soil. But I certainly think every care should be taken to prevent trees getting set as it were from exhaustion of the soil. Manuring, and especially the application of organic matter, ought to be taken in hand early if the flow of latex is to be continued. I noticed in working at rubber lately that in the first latex—as given in older analyses,—the latex contained 32 per cent. of rubber, that is to say, that for 3 lb. of latex there was one lb. of rubber; but in all the latex sent to me recently, and from what I hear from planters the latex does not now equal that proportion, and the caoutchouc has in some instances gone down to 15 per cent. It seems to me the laticiferous tubes are re-filled very rapidly, and the actual flow of water into the tubes also is fairly rapid, but there is apparently a slight want of power of formation of actual rubber in the latex, and this I think must be carefully watched in the future. The yield of the trees certainly has not fallen off, but it must mean that there is a much larger proportion of soft laticiferous tissues and larger secretion of moisture,

which may possibly render the trees more liable to attacks from insects. There is no knowing how this power of the actual formation of caoutchouc in the latex may fall off. It has already fallen off, and for that reason I think, myself, manuring should be taken in hand at an early date. Several people have already applied manure to young trees without thinking of the proper method, which resulted in their putting in a forcing manure producing an excessive head of leafy growth, and which renders them very liable to be blown over by the wind, or have their heads broken off, and I think the greatest care must be taken in the manuring of trees. especially if they are planted in tea and if the flow of latex is to be successfully continued.

Mr. WRIGHT : Might I just mention that Mr. Bamber only refers to exhaustion following the extraction of latex, but I think it is quite probable that there will be far more exhaustion following the excision of the bark, rather than in the extraction of the latex. As you know, unfortunately, we cut off a large area of bark to get a few pounds of rubber.

Mr. BAMBER : Of course, that exhaustion can be replaced in the estate. It is not actually lost to the estate, nor is it removed out of the island.

Mr. WRIGHT : With regard to the composition of the latex, it is interesting to find that though some of the trees at Henaratgoda when first tapped gave only from 40 to 50 per cent. of water in the latex, the tapping of the renewed bark has often given us as much as ninety per cent.

Mr. BAMBER : That is what I say, the proportion of caoutchouc is greatly reduced.

COMPARISON WITH WILD RUBBER.

HIS EXCELLENCY : Is there anybody present who can give us information as to the difference in the proportion of caoutchouc in the extraction from wild rubber trees, which has been going on for a good many years, certainly in the Amazon Valley. I do not think quite so long in Africa. But I think rubber extraction from wild trees—the very old trees—has been going on year after year for a good number of years. I do not know whether any gentleman here is able to tell us whether the proportion of caoutchouc in the latex extracted from those old trees is becoming less.

Mr. BAMBER : I do not know whether they renew the bark like we have to do here, or whether they tap the same trees year after year : but I doubt whether they measure the latex and weigh the rubber as apparently they simply dip their paddles in it and smoke it.

Dr. CHRISTY said there was one point in regard to that subject which was rather interesting, and he noticed Mr. Wright gave a warning on the subject. That was the difference between the two methods of Brazilian preparation and the method of preparation used here. It seemed to him to be a point which was of great interest, and that it was possible it might be found that the success of the rubber industry might depend upon the method of coagulation. No method at present invented turned out the rubber in the same way as Brazil, and it was important that they should go into the matter more deeply than they had done up to date. What he went upon in one respect was the Funtumia rubber in Africa. He had coagulated this rubber by evaporation and sent it home, and that rubber was as good to-day as ever it was—as good as fine hard Para. It seemed to him that one point in the Brazilian method of evaporation was that antiseptic was used in the smoke, and here no antiseptic whatever was used, and the consequence was that they got tacky rubber, and so on. It was possible that if an antiseptic were used they could go on with the present method instead of the evaporation method. It was a difficult and intricate subject and one of great interest, and he was sure it was a very important one. There was a good deal of rubber turned out in South Africa, but he did not think it would make any difference in the market for some years to come. He would like to mention in regard to Funtumia rubber that it was peculiar in this way—that it did not grow here and there as rubber in Brazil, but it grew in patches, and it was quite possible, as he knew himself, to find it growing in certain forests 200 or 300 trees in the acre. Where the trees grew in aggregations and batches, and in very large quantities, it was merely a matter of opening these patches containing grown trees, and thus having ready made plantations as it were.

Mr. CARRUTHERS: That is rather sad.

RUBBER PREPARATION.

Mr. WRIGHT: Regarding the points of difference between rubber preparation in the Amazon and our districts; in the wild districts the proteid and resinous matter is included and the antiseptic added. In the plantation we try to remove part of the proteid matter and the resinous and do not even add antiseptic.

Dr. CHRISTY: Quite so.

Mr. BAMBER: Perhaps we remove a little too much from the rubber. If other rubbers contain all this proteid and resinous matter and give better results, I do not see what we

gain by removing two or three per cent. of resin and proteid matter, and at the same time lose in weight. We certainly want, I quite agree, absolute purity in the factory. I think a rubber factory ought to be kept as sterile as the best dairy, because I have seen how tackiness can start from inoculation. I have been able to inoculate a good biscuit after sterilisation, and there is no doubt that bad weak rubber is often due to inoculation. This can be prevented by having everything in a sterilised condition. Often one sees a layer of proteid and sugary matter left around the biscuits, and there is nothing that will encourage the growth of bacteria more than this. I think that every precaution ought to be taken to see that the implements or utensils used for collection or manufacture should be practically sterile.

HIS EXCELLENCY (to Mr. Wright): Your assumption of the amount of land that will produce a given number of tons of rubber was based, I presume, upon the amount of caoutchouc that has been extracted in the latex up to the present. Assuming as a fact what we have heard—that apparently with an increased flow of latex you may have a decreased amount of caoutchouc, of course, it would effect your estimate as far as the amount of land necessary to produce a certain amount of caoutchouc is concerned.

MR. WRIGHT: My estimate is $\frac{3}{4}$ lb. plantation rubber per tree, per year, from 150 trees on each acre, not so much the latex. We may collect varying quantities of latex according to the climatic and other conditions.

HIS EXCELLENCY: Am I to understand from Mr. Bamber that in certain trees you have handled, we will say last year or the year before, a certain amount of caoutchouc has been found in the latex. This year in extracting from that tree a smaller proportion is found in the latex. Are we to assume that the quantity of latex is increased, but the amount of caoutchouc is constant, or are we to assume that the amount of caoutchouc from the tree is less in the later tapping than it was in the original tapping?

MR. BAMBER: I think the amount of caoutchouc at present is practically permanent, but the amount of latex has largely increased, as you see in the wound response.

HIS EXCELLENCY: That means simply an increase in the evaporating expense of manufacture, and it leaves the amount of caoutchouc constant.

MR. BAMBER: If we started some years ago with thirty-two per cent. of caoutchouc, and we now have 10, 15, or 20 per cent., what is it going to be in a few years? Are the trees going to keep on increasing the amount of latex, so as to keep a constant quantity of caoutchouc?

HIS EXCELLENCY : Yes, that is the question.

MR. JAMES RYAN : I wish to say a few words on this question of acreage. There are two difficulties with which we have to contend. One is the possibility of over-production ; but the greatest danger in front of us is that all this rubber will not come in gradually. The planting has been done so rapidly that we will hurl on to the world, very possibly in the space of three years—which three years I take it will be from 1910 to 1913—we shall hurl on the market this enormous quantity of cultivated rubber, which I estimate will be quite double the present production in three years. The world cannot instantly absorb such a quantity without a severe dislocation of price. We have seen it in the case of our teas and in the over-production of cinchona. I remember in one year Ceylon exported without any warning or with only such warning as we are giving here to-day, four times the world's consumption. What was the result ? Quinine received such a blow that it has never properly recovered from it. We knocked the retail price of quinine down from a guinea or 24*s.* to a shilling. The wholesale price touched as low as 8½*d.* Bark became practically valueless. In tea the moment we exceeded the world's demand by 10 per cent. we knocked down the world's price by 25 per cent. I have talked with political economists on the matter, and they tell us the ratio is incremental and we must bear this in mind and take time by the forelock and introduce our rubber into fresh markets before the crash comes. I have gone very carefully into these figures with Mr. Herbert Wright, and I think his figures are rather an understatement than an overstatement of the dangers we have to face, and I may say that the information he has given to me is that for the 1,200,000 acres at the rate of a ton to 20 acres, which is necessary to produce 60,000 tons of rubber, the land is already planted, and within 5 or 6 years from this date it will produce rather more than less the amount of rubber Mr. Wright gave us to-day. It therefore behoves us all to use our commercial prescience, and without being optimistic or pessimistic approach it with the eye of ameliorists and face our enemies and be ready to meet our enemies well prepared.

DR. WILLIS : I am sorry to hark back, but this question of the dampness is a very important one ; and I should like to show those present here a sample of Para from the Amazon. I have no doubt a good many people have seen it, but I am not quite sure they have all grasped the significance of it. When it was cut it was quite white through the centre. It was rapidly blackening now. It would be seen that the rubber was quite damp. That as it stood was exactly like a Ceylon biscuit freshly taken out of the roller. There was no dry

rubber in that block like the biscuits they sent home. If they rubbed their finger on this rubber and smelled it they would readily recognize the smell of creosote, and it seemed to be a question worthy of consideration whether they ought not to try the effect of blocking their rubber damp. If he might hark back, they made biscuits first in their department in 1899. The methods used then were those used now. They prepared the rubber with acid which nearly every one used now, and they also put in a small proportion of creosote. Raw creosote did not mix with the latex, but it was quite possible to do it. If they mixed creosote with alcohol, one of the former to 10 of the latter, and then added it to the latex the creosote mixed completely and the result was the complete antiseptism of the rubber. There were biscuits lying in the museum at the gardens eight years old as good as ever. There was hardly any mould on them except a little that could be rubbed off with the hand. That rubber from the Amazon was quite damp. He thought it contained 15 per cent. of moisture, whereas in Ceylon rubber there was only about one per cent.; and here was rubber in perfectly good and sound condition, with 15 per cent. of moisture and creosote. The Amazon rubber seemed to him much more springy than the Ceylon rubber. If they took a Ceylon biscuit and pulled it out it would spring back a certain distance and then creep back slowly into the original shape. If they took a piece of South American rubber it sprung back at once. That was one of the complaints against Ceylon rubber in the London market, that its quality is not quite good enough for the finest kind of work, and they should try to improve it in that respect. He suggested that some of the proprietary planters might try as an experiment preparing rubber with creosote, and compressing it into blocks before it was quite dry. It was quite possible they might get better results, and he thought it would be well worth while to try that. With regard to the wild rubber, His Excellency asked if there had been any figures recently from South America, but he was afraid tapping was not done there with sufficient care for that. In South America they simply made a big gash on the tree with an axe, and stuck on a cup with mud. In South America, however, the latex ran for a longer time than in Ceylon in a fluid condition, and Mr. Parkin, who worked in Ceylon in 1898, was of opinion that the latex was of a thicker quality than the latex of the west. He found a large percentage of rubber in the old trees at Henaratgoda, and he was of opinion from the figures that probably, on the whole, the latex in South America was rather weaker than that in Ceylon.

His Excellency the Governor: Is this simply rubber prepared with creosote or with the smoke of a particular nut?

Dr. Willis explained that the preparation of this rubber was done in the following manner :—The man had a large bucket of latex in a liquid condition. He had a paddle in his hand. He dipped the paddle in the bucket, and held it over a kind of flower pot under which he had nuts of a certain palm burning. He revolved the paddle until the latex stiffened, and then dipped it in the latex again, and so on. Mr. Biffen analysed the smoke of that nut and found it was a fairly clear smoke, and contained a large quantity of acetic acid and creosote, and it was on that result that Mr. Parkin based his method for the preparation of Ceylon latex. He based his method on a long series of experiments. He did not know if there was anything else in the smoke. Its marked features were that it contained a quantity of acetic acid and a fair amount of creosote.

Mr. Ryan : In continuation of Dr. Willis's remark, the acid to which the character of this smoke is due is a crude form of acetic acid just as fusil oil is the foreshot of whisky. So the acid is really the cheaper form of the pure acid we are now using, and it might be a moot point whether it were not better to use this pyroligneous acid instead of acetic acid.

Mr. Carruthers said in connection with that matter it might be interesting if he mentioned that some nine months ago a prize was offered in the Federated Malay States for the most chemically pure rubber of any kind that could be prepared. At that time a great many planters were of opinion that what they wanted to make for was chemical purity. It was possible, and he thought indeed probable, that they ran that hare rather too fast. He had sixteen samples submitted to Professor Dunstan and Mr. Gray, who was a partner in the Silvertown Rubber Works, who had a good knowledge of the chemistry of rubber. The samples were in varied forms—many in crepe form, some sheet and some biscuits. The advocates of crepe at that time claimed that by the continuous passing of the rubber through the rollers they got a greater chemical purity than was to be found in sheet or biscuits, and they hoped that their rubber would get the prize, and so crepe would be acknowledged the best. However, when the samples came back, it was found that in regard to chemical purity crepe came sixth, so that passing through the rollers did not give rubber chemical purity. But what was chiefly interesting about the matter was that these samples were also submitted to Mr. Gray for his opinion as to their value for the market, and those which were most chemically pure would not, in his opinion, fetch the highest price in the market so that it was more than possible that, as Dr. Christy and other speakers had said, they were taking something out which it would be of

advantage to leave in. However, if that conference began to make men think of a method whereby simply using creosote, which was the simplest way of imitating the smoking of Brazil, they could cure in such a way as to make fibre or nerve or whatever they might call it, so that they might get the highest price for their rubber, it was a step in the right direction. In regard to the figures Mr. Wright and Mr. Ryan gave, the word "alienated" was used not "planted." As far as the Federated Malay States were concerned if they had taken the figures of alienated land that meant 20,000, 30,000, or 40,000 which was merely taken up, and which it would be impossible to plant for many years. It they had 10,000 acres it would be absolutely impossible to plant it all within ten years, so that if the figures referred to alienation they must be discounted very largely if they wanted to use them for the purpose of considering the amount of rubber produced.

Mr. Wright: In calculating the figures representing the districts to which Mr. Carruthers referred, I may say that Mr. Crosbie Roles and myself, in working out these figures, accepted those Mr. Carruthers gave in his last annual report which is 30,000 merely—very little for your place.

Mr. Carruthers: Oh. I stand corrected. I may say I did not follow them very carefully, but I must say a quarter of a million acres rather staggered me. I do not think my figures assumed such large numbers at that. [Subsequently Mr. Carruthers increased the Federated Malay States' rubber acreage to over 50,000 acres, instead of 30,000 acres].

Mr. Wright: The 250,000 acres cover the whole of the Indo-Malaya region. As a matter of fact the figures gave us nearly half a million alienated, but we only want to take into consideration the minimum 250,000 planted in 1906 to come into bearing in 1913. It is the minimum you can possibly allow for.

Should Government withhold unsuitable Land in Blocks offered by itself.

Col. Byrde said he had been asked to read a paper by Mr. Crosbie Roles, who had seen a copy of Mr. Wright's lecture and based his remarks on them. This statement was as follows:—

While realising that it is easy to prove anything by suppositional figures, I agree with the lecturer that it is wise not to anticipate a reduction in the world's output of wild rubber. Threatened industries die hard; and the output of plantations

cut out of rubber forests and worked under European supervision (as for example Dr. Cuthbert Christy's Uganda concession) has to be reckoned with, though it will presumably be classed by the trade as plantation and not as wild rubber. It will be free from impurities, and will help to balance the Congo stuff with its percentages of impurities very much higher than the Brazilian standard, which the lecturer has naturally taken. As to the demand for rubber, I would give my imagination greater rein. With the inevitable annual, but gradual, reduction in price whole branches of industry, ground plans of which are in existence, will start into being. But whether the demand will, in 1917, be 120,000 tons or 180,000 tons, no one can dogmatically say that no more land than is at present alienated should be disposed of for rubber in either Ceylon or the Malay Peninsula, and least of all in South India. The Ceylon Government will continue to put up to auction, as quickly as it can, land that has been applied for; and the Federated Malay States authorities seem to have no fear that too many of their agricultural eggs are going into the one basket, though they are dependent for much future revenue on the permanency of the industry. I wish, however, to place on record one suggestion applicable to the State policy in Ceylon when large blocks of land, selected by the Government itself, are offered at public auction. In the famous sale of October last, fern land went up with the rest. In the notice of sale had appeared the words "said to be suitable for rubber." This statement reflected the speculative spirit of the period; but in future the State might protect its own and the planter's and general investor's interests much better. It is an economic blunder to sell land that is unsuitable, and I urge that, when it has blocked out areas it is prepared to dispose of, the Government should engage recognised planting authorities to inspect the land, and accepting their dicta, sell for rubber only the acreages they had passed as suitable for rubber. The fees paid to these experts would be more than recovered by the better prices the land would secure; and the ultimate advantages would be far-reaching. The Government would not be, even remotely, a party to land being planted that would be incapable of yielding, say, ½ lb. of dry rubber per tree per annum. Here is a tangible opportunity to protect Ceylon's good name. In the booms of coming years it will be impossible to always prevent unduly heavy profits by middlemen in floating produce companies on the London market; but we can do something now to prevent that greater disaster which will overtake the Colony's reputation if properties which can never properly yield are foisted on to the investing public.

The Making of Block Rubber.

Dr. Christy remarked, in regard to the lump of rubber shown by Dr. Willis that an interesting point in connection with it was that one thin film was placed on top of the other, and eventually by the time it was ready to go to the market it was not only a lump of rubber but an automatic rubber press as well. He meant that each film pressed on the next film, so that in producing this hard block of rubber you would get not only a great amount of power but equally pressing power which exercised a continual pressure.

Mr. Bamber said that there was one other point. With regard to the question of blocking rubber in a wet condition, he did not think it would be quite a wise thing. The amount of moisture left would be a very variable quantity, and he thought the manufacturers at home would be a little doubtful about the rubber. They would find there was a bigger loss in some cases than in others, and at present Ceylon had a name for losing very little in the washing and curing process, and anything which made the quantity of water uncertain might interfere with the demand.

Mr. R. Morison: After the application of creosote, will Dr. Willis admit that drying would do no harm?

Dr. Willis explained that he suggested that merely as an experiment for proprietary planters to try, in order to see what result they would get. Probably the damp would make the quantity of rubber uncertain, but it was not difficult to devise machinery to get over that difficulty. It should be quite easy to devise machinery which would make the amount of water in a particular block of rubber fairly uniform.

Mr. C. Devitt: That block of rubber is dried in layers, but it has water in between each, and it would never do to mix creosote with the Ceylon rubber in making one block. It would be wet and also not properly cured. In this block each layer is dried, but it has got the water in between. It is not one mass. It is in hundreds of different layers, but in a plantation like Lanadron the block produced is all one piece. If you mix creosote with the latex you could never dry it in one mass. You would have to smoke each layer just the same as in the Amazon block.

Vote of Thanks.

H. E. the Governor: Mr. Wright has given us a very interesting lecture, and I think the discussion has been of very great value. I think we have to thank Mr. Wright for the great care with which he has prepared his lecture, and also the gentlemen who have spoken on the subject, for the information they have given you, gentlemen, and planters as to the work in the future.

CHAPTER IV.

CATCH CROPS FOR RUBBER PLANTATIONS.

WE may now pass on to give the lectures dealing with the various catch crops possible upon rubber plantations, premising that of course those given here do not exhaust the list. In particular, attention must be directed to the fact that there are many catch crops of what may be called a permanent nature, such as cacao, camphor, tea, and other long-lived plants. If such catch crops as these—if they can be called catch crops—are to be planted between the rubber, it is evident that the latter will have to be planted further apart than in the first chapter of these lectures we considered necessary. But in this place we need only deal with catch crops in the sense that they are crops to be taken from between the rubber for periods varying from one to six or seven years, according to the crop chosen and the distance a part that the rubber is planted.

Of such crops, for general use, probably the most profitable are in the dry country cotton and tobacco, in the wet country lemongrass, citronella, tapioca. In addition to these, we must not forget that many people prefer, instead of growing any actually cash-payment crop, to cultivate green manures between their rubber, for the sake of the enrichment of the soil.

There is no doubt that at the present time most people do not want to be bothered with catch crops, preferring to wait till their rubber is tappable. But at the same time, there is also little doubt that many people have "bitten off more than they can chew" in this respect, and will be pinched for money before that period arrives, and for such the somewhat fragmentary information given here will be of value.

We shall give first the lectures dealing with the "dry" country, in which the experiments at the Maha Iluppalama Experiment Station give reason to hope that a large area will prove available for rubber, and then those dealing with the wet country.

Rubber and Cotton.

By Dr. J. C. Willis.

The first of the series of lectures given during the Exhibition was held at the Governor's Pavilion. His Excellency presided.

Dr. Willis said that the title of his lecture showed that he was going to deal with the north country as suitable for rubber and cotton. and he would like to make one explanation. Some people were under the impression that they could grow cotton successfully in "wet Ceylon," if he might use that phrase; but though in exceptional years it might be possible, as a rule it was not possible, and he was entirely against recommending any one to try to grow cotton in wet Ceylon. This he demonstrated by making a rough sketch of Ceylon on the blackboard. The mountains of Ceylon lay in a block. He drew a square by lines from the coast inland, one running from Negombo in the direction of Trincomalee and the other a little east of Matara, which, if continued, would come out about Batticaloa, and a third line running north-west and south-east of the mountains joining these. This he indicated was the wet region which got both the rain of the south-west and north-east monsoons. The remaining part had only rainfall in the last three months of the year, and for the rest of the year was comparatively dry. They sowed cotton in September or October, and the first crop came in March; and if they got rain from March to the end of June, their cotton crop would be more or less a failure. If it rained when the cotton was in the boll, that was when the pods fluffed out, the cotton crumpled up and no amount of drying would make it really good. They might dry it and get *2d.* or *3d.* less for it than otherwise, but by no amount of drying could they get really first-class results. They now came to the subject of his lecture, Rubber and Cotton.

When the northern country was opened by the extension of the railway the question immediately arose as to whether some product suitable to the country could not be introduced, and naturally the first thing to be thought of was cotton, and Government agreed to open an experiment station at Maha Iluppalama, about 12 miles from Talawa station, and on the

road which in the future would be the main road through the North-Central Province. The object of that experiment was first of all to try cotton, and as soon as they got the cotton into shape, they also tried rubber, that being a fairly promising industry for the north country. For the first 9 to 12 months they had nothing there but cotton. They had enough difficulty with that. It was an extremely difficult country in which to get labour, and the coolies took life very easily and did not over-exert themselves and demanded 50 cents a day for doing it. It took a great deal of time and trouble and expense before they got things square and the cotton in. They got the land fairly clear and rubber put out in October, 1904, and at intervals up till April, 1905. That was only about 16 months ago, and the trees were now from 8 to 12 ft. high, varying in height according to the time they were put in. The diameter was anything from 1 to 2 inches, and the trees were growing very satisfactorily. Mr. Mee, who was in charge of the station, had had experience of rubber in Kalutara, and he thought that on the whole the trees were growing as well as they did at Kalutara. Of course, they had not got to the tapping stage, and until they had got to that stage he would not like to make any definite statement that rubber would succeed. But if it succeeded as it promised to do, it would open up a large area for cultivation when the land in the south and south-east had been taken up. They had there a very good soil. A false impression had been publicly created about the soil in the north. It was much talked about during the preliminaries of the northern railway, and it was described as a desert, and nothing but gravel and sand. That was by no means the case, and if any one cared to go down to the station they would see soil which could not be seen anywhere in south Ceylon. Any one who had visited the Experiment Station at Peradeniya knew they had very good soil there, but the soil at Maha Iluppalama beat the Experiment Station here, and was really very good indeed. Of course, going down the north country people went by the North road and travelled along the highest ridge of the low country, but if they came into the valleys where they were they would find a deep alluvial soil which ran 10 to 15 feet deep in the centre of the valley and tapered off to from $1\frac{1}{2}$ to 3 feet deep on the sides. The depth of soil in the centre was in places 17 feet; they had dug that depth and still there was no stone to be seen. It was a perfectly soft blackish soil like an English garden soil, and its quality was extremely good. It was on the whole better than any soil they could see in the Central, Western, or Uva Provinces, except perhaps the soil on the eastern side of the range near Lunugala.

To return to the cotton crop, they sowed it in September and October according to the rains, and the first crop came in March. They must have fine weather from the beginning of February. The flowers come out in February, the first crop was in March, the second six weeks later, and the third crop, which was a small one and hardly worth waiting for, came about the end of June. They had had considerable difficulty with labour, which cost them a good deal more trouble than it need have done. Of course, they were pioneers, and he thought any one following after them would be able to bring coolies on advances, and do it much cheaper. Since the railway had been opened they had reduced their rates from 50 cents a day to 41·25, a drop of 8 or 9 cents, and some of the coolies seemed inclined to do a little more work than formerly. He would not trouble them with returns, but for their Sea Island crop, which was got from a field of 20 acres, they got Rs. 87 an acre, and the return from the Egyptian crop, of which they had 30 acres at the end of 1904 and the beginning of 1905, was Rs. 71·25 an acre. The Sea Island cotton was, of course, the best grown in the world. It owed it quality entirely to selection of the seed, and if they were not very carefully selected the quality dropped immediately. Their seed was taken from a West Indian crop that sold for 1*s.* 2*d.*, and they sold their crop for a shilling. Their seed had not been selected. The only people who could have selected it were the West Indian Agricultural Department, and they had their work cut out for them in selecting seed for themselves. They were getting in the West Indies 1*s.* to 1*s.* 6*d.*, but he saw in the last sale list that one or two got 1*s.* 8*d.* The price had steadily gone up by careful selection of seed. Their seed was not selected, and the price dropped from 1*s.* 2*d.* to 1*s.* in one crop.

Now, to take cotton and rubber together. He thought that in the north country there was quite a prospect, as far as they could tell at present, of a profitable industry in cotton as a catch crop between rubber. They could not grow it in the south as a catch crop, but, in the north country, where it was dry, it was quite feasible. He drew a sketch on the blackboard illustrating how rubber and cotton should be planted together. They planted the rubber 20 feet apart with irrigation channels running down midway between the trees so that each tree had an irrigation channel running down 10 feet on either side of it. The black soil held water very well, and that channel was only turned on an hour or so a day, according to the weather, and a little trickle was quite enough to keep the trees growing well. The cotton was planted 5 feet apart in the 20 feet clear between the rows of rubber.

They might put in three rows of cotton by moving the irrigation channel a little on one side of the middle. In the second year the rubber trees would have grown to a height of 10 or 12 feet and would shade the cotton. The trees would be, as most people knew, unless they were thumb-nail-pruned or were of a spreading variety, thin, tall trees, and a considerable amount of sunshine would be allowed to the crop. In the second year, therefore, they might have two rows of cotton. In the third year they would have one row, and after that the rubber trees would be too large to make it worth while growing cotton.

Although the country was dry the air on the whole was damper in the north than in the Central Province. Mannar had, for instance, an average saturation of 81 or 82. At Peradeniya, which was in a rainy district, the average saturation was 78. Provided they supplied the roots with water by irrigating channels they would do well. The air was not too dry to prevent their growth. That was the positive side of the picture. The negative side was that malaria was exceedingly bad in the North-Central Province, and any one taking up land must be prepared to face a good deal of fever himself and amongst his coolies. They were in hopes that by means of that new oil method explained by Messrs. Bamber and Green they might be able to treat coolies in such a way as to prevent their getting fever, at least to a considerable extent. It was idle to think that the cooly would stay in a mosquito proof house even if they made one. The probability was he would close the curtain with care and then sit on the verandah. One must adopt something more practical to keep him clear of the mosquitoes, and he thought there might be some hope in that method of Messrs. Green and Bamber.

The Discussion.

His Excellency : Have you any specimens of the oil to-day, because it would be interesting to the gentlemen present to see them. The kerosnie is entirely concealed.

Dr. Willis : Yes, I should like to call public attention to this oil method. The mixture consists of—

$1\frac{1}{4}$ parts of Citronella oil.
1 part of Kerosene oil.
2 parts of Cocoanut oil.

and for every 100 parts of the mixture add one of Carbolic Acid and shake well.

The resultant mixture has no smell of kerosine. Citronella has a very penetrating smell and the mixture smells like weak citronella, but it does not evaporate so quickly as citronella does. It leaves no smart like citronella, and will not

evaporate for at least six or seven hours. If a cooly oils himself at five o'clock in the evening he ought not to be eaten by any Anopheles that night, and I think the coolies would very likely be benefited. I see Dr. Christy is present, and he will be able to speak as to that.

Dr. Christy: I think it is a very good plan indeed, but there are many other things which may be carried out very successfully. Still, the oil method is a very good one, and ought to succeed. I have noticed on some of the plantations in Ceylon the cooly lines are very much at fault. They might be built on the high ridges with a hundred yards clear all round, and away from the water. The coolies might be made to carry the water from down below. One might make the lines in fifty different ways so as to minimise the chances of getting malaria.

His Excellency: What part of the country, Dr. Christy, have you visited ?

Dr. Christy: I have been to the Kepitigalla Valley district.

His Excellency: I think the Public Works, as a matter of fact, have not suffered so much as you have at Maha Illupalama with the coolies, and they attribute it to the position of their lines, and to the excellence of the lines built by them. Have you heard anything about that ?

Dr. Willis: No, Sir. The coolies could have had their lines close to the bungalow, which is a mile from the Experiment Station, but every cooly is said to have preferred to go to the Experiment Station, which is six or ten feet lower than Mr. Mee's bungalow. There they can have little gardens around the house owing to the fertility of the soil, and water is plentiful. There is a good deal of malaria among the coolies down there, but on the other hand Mr. Mee suffers a great deal, so I am not sure that his bungalow is very much more proof against fever than the cooly lines. Of course, the fever varies with the season. Just now there is no malaria and there are no mosquitoes.

His Excellency: Is Mr. Mee's house protected ?

Dr. Willis: No.

His Excellency: I thought an arrangement had been made to protect it.

Dr. Willis said it was not put through, but there was a scheme for building an upstair bungalow.

His Excellency: One of the fallacies that exist is that mosquitoes will not go upstairs. I am in a position to say that they do.

Mr. Carruthers: We in the Straits believe that fallacy, and our lines are built on brick pillars six feet from the ground. One of the results is that the cooly uses the place underneath

for his cooking, and the smoke passes through the cracks in the boards. I believe, speaking with due deference to Dr. Christy, that this has a certain effect in preventing insect pests by the smoke trickling through the room, and driving the mosquitoes away.

His Excellency: Yes, there is a good deal in that.

His Excellency: Have you tried administering quinine?

Dr. Willis: We use it by the hundredweight, I was going to say, but at least by the 20 lb. lots.

His Excellency: Do you find a good effect?

Dr. Willis: It has a certain amount of good effect. Some coolies cannot stand the country. We find two kinds of coolies: the Batticaloa Moors and the Kurunegala Sinhalese stand the country best. Of course, they have a fever of a very malignant type at Kurunegala. Of the local people, the women, for some reason that I don't in the least understand, are very much better than the men. We have much of our work done by women coolies; the men are emaciated and listless, but the women work fairly hard. I do not know the reason for that.

His Excellency: I think the idea of the Medical Department at the present moment should be to combine these experiments—the administration of quinine with this anointing with oil. It will be very interesting to find that, between the two, the amount of sickness in the labour is materially decreased. Talking about rubber, you tell us, Dr. Willis, that the saturation is greater in the Northern Province than here.

Dr. Willis assented.

Prevention of Dysentery.

His Excellency: A large number of gentlemen who are interested in that question are present, and it would be well if they saw the oil and found out for themselves how agreeable the perfume of it is. When you mention coconut and kerosine it does not sound very nice. I think this is the line upon which you will find the most effective defence against malaria.

Mr. Kelway Bamber: I think its employment should be combined with everything else that can be done.

His Excellency: Quite so. There is another question in connection with this matter which it may be interesting to mention. Malaria is not the only thing from which coolies suffer. You know perfectly well that there has been a great deal of dysentery among coolies here and elsewhere, here and in other countries, and I may tell you that Mr. Martin—I was in hopes he would be here—informed me a short time ago that he had given his coolies tea. He gave them this

tea morning and evening, and with most excellent effects. The reason is this. Coming lately as I have come from China, I may tell you that there is hardly any dysentery there or any complaints of that kind, all because the people never drink cold water. They drink nothing but tea, or at least they call it tea. As you go along the roads in China you see men sitting with a number of small tea cups before them and a kettle of boiling water. The tea leaves, as far as one can see, are not even withered. The man takes a few of these leaves, puts them into the kettle, fills it with boiling water, and that is what he drinks. They never drink water, and the consequence is that they never suffer from the complaints we hear so much about in Ceylon. If gentlemen who are here so largely engaged in the production of tea can induce their coolies to drink tea, it may have a very considerable effect.

Dr. CHRISTY agreed.

HIS EXCELLENCY: It might be worth trying. If you get four million people to drink the tea you are now sending down to the harbour it would give you a market at your doors. I mention it because it is a simple thing and might be worth trying.

Mr. JOWITT: It is a question of caste. A great number of coolies will not drink tea. The lowest castes will drink it, but not the high castes.

HIS EXCELLENCY: That may be so. I would save the low caste coolies if I could.

AVAILABLE LAND IN THE NORTH.

HIS EXCELLENCY: Well, we have all remarked that in that dry section of the country, before you come to Elephant Pass, you have jungle which even at the end of a long drought is perfectly green. That argues to my mind that there is a certain amount of moisture in the soil at a certain depth, and for the purpose of discovering whether that is so a water survey is being carried out by the Survey Department. Granting that you have at a certain depth—eight to ten feet—soil which retains the moisture, would it be sufficient to ensure the growth of rubber and its continuance through the dry weather?

Dr. WILLIS: If the rubber got its roots down they would be all right; of course, our experience is very limited in this district. We had rubber trees at Anuradhapura which we planted in 1894, and they grew very well up to 1898. In 1898 they were four inches in diameter. Then we had a record drought. There was no water in any of the tanks, and things came to such straits that we had to lend garden coolies to

help to dig wells to get drinking water for Anuradhapura. And the result was the death of every rubber tree in the garden. I imagine that, being near the ela, the roots remained near the surface. I would not recommend anybody to try rubber there without a guaranteed supply of irrigation water and that is a bit of a difficulty at present.

HIS EXCELLENCY : There is a large quantity of land available at Minneriya.

DR. WILLIS : About 15,000 acres, but it is so far away, and is, I think, the most malarious place in the Island. However, I think that difficulty can be removed. The district could be cleared of malaria because the mosquitoes breed in the tank. Dr. Willis explained, that, owing to the sloping character of the bund, there was a great deal of shallow water which was "saturated" with mosquito larvæ, and if the bund was taken straight down this could be obviated.

There was very good soil, 10,000 acres of land, in that district, all of it flat, with good soil, reaching down to the Mahaweli-ganga. He thought this was the finest piece of irrigable land in Ceylon. The tank was made, and water was plentiful, and it only needed the malaria to be taken in hand.

The proceedings then terminated.

Tobacco.

By MR. M. KELWAY BAMBER.

The lecture by Mr. Bamber took place at 4.30 P.M., and was well attended.

MR. KELWAY BAMBER, who was cordially received, said :—

Ladies and Gentlemen : My lecture this evening is merely to give a brief description of the growth of tobacco in Sumatra, and the prospects of growing it in Ceylon as a catch crop or a main crop up in the North. The growth of tobacco in Ceylon is as yet quite a minor industry confined almost entirely to native cultivators, but it is hoped that, notwithstanding failures in the past, the industry may be much improved and extended in the near future. We have the experience of several countries, notably America and Sumatra, to guide us in any investigation that will be undertaken here, and if properly conducted on scientific and practical lines, there is every prospect of success. Already a considerable area is under tobacco in Jaffna, Dumbara, and some other suitable districts, but the methods of manufacture or curing employed are crude in the extreme, so that the results are not satisfactory as regards

producing a tobacco suitable for the European market. The tobacco industry is now so highly specialised that a nondescript tobacco is no longer needed and brings only a very low price. The qualities of the tobacco leaf including the size, shape, thickness, flavour, and aroma, grain and style, are so delicate and so easily influenced by climatic and cultural condition, the former of which are so difficult to control, that it is impossible to say what kind of leaf will result under new and untried conditions. The fact also that the quality of the tobacco cannot be judged until after the long and careful treatment necessary in the curing and fermentation of the leaf to develop and fix the style and aroma, makes the investigation even more difficult, especially as it can only be done successfully when working with a large quantity of at least 2,000 lb. For such investigations it is necessary that a small experimental station be established in the centre of one or two of the chief districts, and the whole subject of seed, growth, cultivation, and preparation worked out in a scientific manner, special attention being paid to the improvement of imported or native leaf to adapt it to the present market demands.

For the manufacture of cigars three types of leaf are required, viz., the wrapper, binder, and filler. The most important of these, from a commercial point of view, is the wrapper, as the value of a cigar largely depends on its appearance. A leaf to be used as a wrapper for the present market demands must have quality and style, be uniform in colour, free from holes and tears and very elastic, and of a suitable size that it can be economically employed without waste. Its flavour and aroma must be mild so as not to mask the desirable qualities of the filler, which tobacco must have a rich aroma and desirable flavour. The best Cuban tobacco has a characteristic aromatic flavour which, it is believed, can be developed by selection and breeding, and it has been found to be the most serviceable leaf for filling purposes, and is generally taken as a standard. The size of the leaf should be 12 to 14 inches, and it should not be very dark and heavy, but of medium body, of a rich brown colour, burning smoothly and freely. It is generally agreed that a cigar should not be made of only one kind of tobacco, but careful blends made from leaves from different districts until the most satisfactory blend is arrived at and a new brand of cigar can be placed on the market. It must be well recognised from the first that the trade cannot be forced into taking any brand or type of tobacco that is produced, and before commencing experiments in Ceylon it would be advisable to ascertain the kinds most suitable to copy, and, if possible, to obtain the opinions of

experts on the present various types of Ceylon leaf and as to the possibility of their being improved for blending purposes; also the lines on which such improvement should take place. In America it has been found that the Sumatra leaf for wrappers and the Cuban leaf for fillers are the most desirable, and the respective methods of cultivation of these two varieties have been carefully carried out with excellent results.

It must not be supposed that one method of cultivation and curing can be carried out for all varieties of tobacco, as the result would be direct failure, seeing that the object to be attained is so different in each case. For Sumatra leaf the soil must be exceedingly rich, so that the growth is quick, resulting in thin smooth elastic leaves. It is also necessary that the plants are fairly close in the rows, otherwise coarseness and unevenness are certain to follow, rendering the leaf unsuitable for wrapper purposes. A soil which will produce a filler leaf of fine quality will produce a wrapper leaf which is too heavy, strong, and dark for the present market demands. Strong heavy soils, as a rule, are suitable for fillers, and light free soil for wrappers, much depending on the physical conditions of the respective soils. But it is curious to note how in various tobacco countries certain qualities of leaf can only be obtained in localised areas, where the climatic conditions differ only slightly from the adjacent hills, and the plant seems to be exceedingly sensitive to meteorological conditions which are too slight to be recorded. In Cuba tobacco of good quality cannot be grown close to the sea or in certain parts of the Island even on what would otherwise be considered good tobacco lands. This has also been the experience in Sumatra and America, and no doubt will be found to be the same in Ceylon. The climatic conditions in the best tobacco districts of Sumatra between the months of March and August, which is the tobacco-growing season, are somewhat similar to the conditions prevailing in the drier district of Ceylon more or less exposed to the north-east monsoon. During the 184 days of the above period, there are, on the average, 59 wet days with an average total rainfall of 40·1 inches. Both the number of days and the total rainfall, however, vary considerably and range from 38 to 88 wet days with a fall of 20 inches to 73 inches, showing that a rather wide margin is available to choose from when selecting suitable districts. Almost all the Sumatra tobacco district lies along the east coast and is more or less protected from the west by a long range of mountains. Most of the area is perfectly flat, and the soil consists of finely divided clayey or sandy loams derived from volcanic detritus. None of our soils are apparently derived from the same source, but physically many of them compare favourably with Sumatra

soils on which high-class tobacco is grown, and have, if anything, somewhat higher retentive power for moisture, an essential condition for successful cultivation.

The system of agriculture adopted on most of the largest estates in Sumatra struck one as being as near perfection as possible, and probably no place in the world has more thorough care given to the cultivation of a crop than by the Chinese coolies working on these estates. From the clearing up of the jungle after felling to the harvesting of the ripe leaves of the tobacco plants, the closest attention is given to every detail of cultivation; every trace of jungle, excepting the stumps, is collected and burned and the soil perfectly levelled like a smooth garden, probably one of the main objects of this thoroughness being to destroy, as far as possible, every trace of insect or other pest. In the preparation of the nursery equal, if not more, care is given; the seedlings, carefully shaded, are attended to day and night, every insect found being destroyed. When in Sumatra I noticed that the Chinese coolies were going round on moonlight nights, carefully searching for worms and examining every leaf of the thousands of leaves in the nurseries to remove every caterpillar or anything that would cause any mark on the leaf. Every six days new nursery beds are made in succession, so that a constant supply of plants of the right age is available for planting up the area required. The beds run from east to west and are usually 3 feet by 18 feet, which produces about 2,000 plants. They are carefully shaded for a month or five weeks, after which the shade is removed for use on another bed. The plants are usually ready to be transplanted in from 45 to 50 days from the sowing of the seed. Transplanting begins about March, and goes on until June, after which is too late for satisfactory results. The pulling of plants for transplanting only takes place early in the morning, the plants being pulled while still wet with dew or after thoroughly soaking the bed with water. Only the healthiest and greenest plants are used, and these are placed in a basket as pulled and covered with a cloth until the evening, when a plant is dropped by the cooly opposite each hole previously prepared and watered, and when all are dropped planting takes place, the roots being carefully and firmly secured so that a slight pull would not remove the plant. The same evening, or early the next morning, shade planks are fixed in the soil over every plant so that they get the early morning sun, but not the noonday or afternoon heat. As the plants grow the planks are straightened up and finally removed twelve to fifteen days after planting, the soil then being heaped round the plant to protect it from the hot rays of the sun. Each cooly undertakes

planting and attention to $1\frac{1}{3}$ acre under the direct superintendence of the planter who has to see that all the work is thoroughly done and the plants secure in the soil, as scamping of the work occasionally takes place. All cultivation is done by hand, the land being hoed three times in the season and the plants gradually and carefully earthed up, but it is advisable that this should not take place when the leaves are beginning to ripen, otherwise they lose somewhat in quality from apparently a restart in vitality as the result of the stirring of the soil. If the weather is dry during the few days after planting, watering each plant has to be adopted and only pure stream or well water is used for this purpose and not any dirty ditch water. As a general rule there is a ditch or pond near the beds or near the acre the cooly is looking after, the water of which is more or less dirty. Although they often have to carry fresh water a considerable distance, they take the precaution of doing this instead of taking the water from the ditch or pond which might add insects or possibly some fungus to the soil.

When 12 to 15 inches high the cooly removes all the leaves at the bottom of the plant, places them against the earthed-up roots and further covers them with soil, taking care also to cover the wounds on the plant to prevent drying by the sun. The third and last cultivation takes place when the plants are about 2 feet high, the rows now standing on fairly high ridges so that they are well protected from the heavy rains. When the plants are forty or fifty days old, flower buds begin to come up and are pinched off. It is usual to leave 15 to 18 leaves, but sometimes 24 are left on. After topping suckers come out, and are continually removed. If topping is done at the proper time the tobacco is usually ripe and fit to be cut three weeks later. The plants when ripe have yellowish appearance and the leaves, especially the inside ones, have little light brown lumps and take on a somewhat swollen appearance, while the edges commence to curl up towards the underside and assume a dark brown colour. The time from transplanting to harvesting is from seventy to ninety days. The plants are liable to several diseases, necessitating the closest vigilance on the part of the cooly to at once check any disease immediately it appears. He realises that it is his own interest to have the leaves free from holes, and rarely has to be urged to attend to this matter ; but if neglect is apparent from the look of the yield, he is made to attend to it at his own expense. Formerly, the entire stalk of the tobacco was cut and brought to the drying shed, but recently the system of pruning has been adopted. In this method the leaves are taken off from the stalk and carried to

the drying shed in baskets. Every care is taken only to pluck the leaves as they arrive at the correct state of ripeness, and there is no doubt, I think, that this is one of the main reasons why the Sumatra leaf fetches a very much higher price than other leaves where the whole plant is cut at the same time, because when the whole plant is cut the lower leaves are several days over-ripe, while the upper leaves are several days under-ripe, and it is impossible either to dry them correctly or produce even fermentation in the latter process. Some growers prune off half the leaves in this way and then cut the balance of the stalk. Tobacco is never cut or pruned when wet with dew or rain, as this causes little holes in the leaves, lowering the value. The contract with the cooly ends with the delivery of the tobacco to the drying shed.

It will be seen from the above description what care is necessary in the cultivation at every stage, and it remains to be seen whether the same amount of care will be given by the native of Ceylon, but personally I think this will be forthcoming if the reason and necessity are carefully explained and the financial advantages that he would reap by producing a leaf of the finest quality only. About the beginning of the season an acre and a third is given out to each cooly, and advances are given to him for the working during the time of the making of the nurseries, planting out, and attending to the plants during growth ; but at the end of the time when the leaves are ready for plucking, he plucks them with the aid of Javanese or other coolies and takes them off to the drying shed, where he is paid at the rate of 6·40 guilders per thousand for the best and 80 cents per thousand for the worst. The leaves are strung through and hung on slats, ten plants per stick. They are hung one day on the lower supports and then removed to the top of the shed, the shed being filled from top downwards. Care has to be taken that no green tobacco is hung beneath partially cured tobacco, so that when the first leaf is partially dried it is removed to the top of the shed and then gradually lowered, the next day's leaf being placed over it.

The Discussion.

Dr. Willis said he was sure they all felt they owed a debt of gratitude to Mr. Bamber for his interesting lecture. He had no doubt that tobacco was a thing very few people had thought of in connection with Ceylon. Hitherto it had always been planted (by Europeans) in wet districts, and tobacco was distinctly a crop for dry districts. Few seemed to have realised that, if cultivated properly, nothing on the whole could be so profitable as tobacco. The reason he supposed

why it had not been taken up to a larger extent was that it was only in limited districts that it could be successfully grown. He was looking at a list of Sumatra Companies the other day, and he found to his surprise that they paid dividends ranging up to no less than 240 per cent. on tobacco. Sumatra Companies were distinctly the most prosperous companies planting anything in any part of the tropics, and even in Ceylon, where at present they only grew a poor quality of leaf, he was told recently by a rich landowner that some tobacco grown in the Chilaw District—the growing crop—was sold at Rs. 750 per acre, which was not a bad figure considering the comparatively small cost of sowing, growing, and cultivating it for a few months. He did not mean to say that they could get the same price every year. This was an exceptionally good crop, and it was a favourable year, the prices of tobacco going very high last year. This year the prices were very low, for the simple reason that the cultivators increased the area of cultivation when prices went up, so that the prices went down; then they decreased the area, and the prices again went up. The same thing had gone on for years.

The opening of the Northern railway had brought within reach a great area in the Northern Province which would grow tobacco very well. In the experimental station at Maha Ilupalama they had raised good crops of common Chilaw and Jaffna leaf, and it was being sold in Jaffna, but owing to the comparative slump in the market it would not realise as good prices as usual. One thing they had to remember about the cultivation of tobacco, and that was that they must have a particular kind of soil; he believed—Mr. Bamber would correct him if he was wrong—that they must have soil with plenty of lime and potash, and no one should expect in any place in Ceylon to be able to grow tobacco unless the soil contained a good amount of potash and lime, but so far as his knowledge of the northern country went, there was a very large area now available within easy reach of the railway both in the North-Central and the Northern Provinces which would grow tobacco well. Whether they would grow a quality equal to Cuban or Sumatra leaf was another question, but it seemed to him there was little doubt that if any one could grow good tobacco on a large enough area to ferment properly there was a fair prospect of financial success. Hitherto, as people knew, the tobaccos of Jaffna and Dumbara were used for cigars and cheroots, and, of course, these were distinctly smokes and not cigars. They were very rank and gross, and any one who had seen the curing done would realise why this was the case. The biggest area was one-tenth of an acre, and they wanted at least 2,000 lb., the produce of several acres, to give the minimum to cure

properly. Again, well-cured tobacco took three weeks, and the maximum period in Ceylon he had seen it cured in was five days. It was generally heaped on the ground and covered up with sand and fermented for a day or two, and then taken up and dried, which was not the proper way at all. If any one selected a good piece of land and selected two or three jats of tobacco and cured the tobacco properly there was a fair prospect of success, but it would take a great deal of experimenting yet to find out exactly what to do.

Mr. EDGAR TURNER: You have not mentioned anything about elevation. We have always heard that the good flavour in the Turkish tobacco is due to its being grown at a high elevation. Is there any chance of tobacco grown at high elevations in the Central Province having a better flavour than that grown elsewhere?

Mr. BAMBER: I have not heard of any being grown at high elevations in Ceylon, but it is possible it would.

Mr. TURNER: At what elevation is it grown in Cuba and Sumatra?

Mr. BAMBER: In Sumatra it is almost entirely grown at sea level, but there is some running up to 600 feet.

A vote of thanks having been passed to Mr. Bamber for his lecture, the proceedings ended.

Lemon Grass.

By Mr. HERBERT WRIGHT.

Mr. HERBERT WRIGHT had an informal talk on the subject of lemon grass cultivation with a few gentlemen interested in the subject last evening, and explained the process of distilling and refining the oil. Mr. Wright first pointed out the samples of lemon grass in the machinery shed, where the talk took place, and said they were the ordinary plants they had in Ceylon. The lemon grass seeded in India, but at Peradeniya it did not often produce proper flowers.

Mr. WINTER, Baddegama, remarked that it rarely fruited in the Southern Province. They might find one or two flowers in an acre.

Mr. WRIGHT, continuing, said they usually planted the grass slips 2 or 3 feet apart. They divided each stool into numerous slips and placed each slip in a mamoty hole. Hitherto it had mainly been cultivated in the south of the Island. They had now succeeded in cultivating it fairly successfully at 1,600. It was an easy plant to propagate. They got slips in 1902 and from these they had planted 15 acres as well as distributed thousands of slips in Ceylon and to India and the

Straits. Nothing they had distributed had yet come into bearing, although, as a matter of fact, they could get the first cutting in 6 or 9 months, and after that every three or four months, during the second year. Proceeding, Mr. Wright explained the working of the still, and pointed out that in Ceylon estates they usually had long condensing pipes running along the riverside. In this case the whole of the condensing apparatus was confined to a very small area. There were 60 feet of coiling inside the tank (which he indicated) and the actual supply of water was very small. The condensing pipe in that instance was made of ordinary iron, but it was better, to prevent corrosion, to have it made of pewter or white metal. When they got the crude oil it was mixed with a lot of impurities. It was first filtered through an ordinary rough cloth, then through a fine cloth, and ultimately through filter paper. He showed samples of the material in the various stages. The Peradeniya product was of somewhat different colour to that of the Southern Province, and the first distillate was placed in a small copper still and refined. By that refining process they lost a good deal in weight.

He showed a sample of the residue obtained after refining the crude oil, a thick treacly mass, which he said would melt at a slightly higher temperature than that of the atmosphere. The residue in the case of citronella and lemon grass varied from 20 to 30 per cent. On most estates it was not customary nor necessary to refine it.

Mr. Winter: What is the quantity of citronellal in it?

Mr. Wright: We had samples analysed by Mr. Bamber and analysts at home, and the analyses gave 66·5.

Mr. Winter: In the purified oil?

Mr. Wright: No; in the crude. They valued the crude oil at home at 8*d*. per ounce. Since that time the price has fallen, and perhaps we could not now get more than 4*d*. per oz. If you work out the proportion of fresh grass per acre you will find that lemon grass and citronella are very exhausting. Every 10,000 lb. of fresh lemon grass contain 65 lb. of potash, 12 lb. of nitrogen, 12 lb. of lime, and 9 lb. phospheric acid. One cutting from 2 acres gave them 16,000 lb. of grass; another cutting from 3 acres gave them 15,000 lb., while another from 5 acres gave 38,000 lb., so that when they totalled these up they would find the crop was rather exhausting. They could, however, return everything to the soil with the exception of the nitrogen. They could use the dry grass as a fuel, and then they would only lose the nitrogen. The ashes could be put back on the land, and thereby they would avoid the loss of lime, potash, and phosphoric. They had sent home several

tons of dried grass after the oil had been extracted. The people at home were rather keen on it, and only the previous week he had a letter from one firm asking him to send another $2\frac{1}{2}$ tons at once. They were using it for making paper, and it compared favourably with esparto.

Mr. WINTER : It can be used for cattle food.

Mr. WRIGHT : Yes, I believe at Baddegama you allow the cattle to chew it.

Mr. WINTER : We got some Sind cattle from Colombo, and they were fed entirely on it, and have become quite fat.

Mr. CORYTON ROBERTS : How does lemon grass compare with citronella ? Is it a better crop ?

Mr. WRIGHT : Lemon grass has a much smaller leaf and I think is less exhausting ; but whereas you require 500 lb. of fresh lemon grass to give you 1 lb. of oil, you only require 250 lb. of citronella to give you the same quantity of oil.

Mr. ROBERTS : Would citronella do as well for paper making ?

Mr. WRIGHT : I do not say it is equally good. They are trying it just now. We have sent four consignments home—one of dry steamed citronella, another of dry steamed lemon grass, another of dry steamed mana, and another of ordinary mana grass. We have got fairly good results, but the people at home prefer the steamed mana. The question of freight will, I am afraid, seriously operate against anything being done outside Ceylon in this matter.

Mr. ROBERTS : It would not cover expenses ?

Mr. WRIGHT : I do not think it would, but it is interesting to know we have a waste product that people think they can use.

In reply to further questions, Mr. WRIGHT said they got approximately from lemon grass 20 lb. of oil per acre and from citronella 50 lb. The last consignment of lemon grass that went home fetched 8*d*. per oz. and that of citronella 1*s*. 6*d*. per lb., but since that time, as he had said before, the price of lemon grass had fallen, and there was a chance of another plant—Backhousia—grown in Australia and other places, which would give a product quite as good.

Mr. ROBERTS : Has citronella gone down in price ?

Mr. WRIGHT : No ; I believe it is to-day over 1*s*. 5*d*. per lb. The price has in fact gone up.

Mr. ROBERTS : Then citronella is not affected by this new product ?

Mr. WRIGHT : It may be, but there are no signs as yet. He added that they got six slips of lemon grass in 1902 and they had planted over fifteen acres. Of citronella they got 10,000 from Baddegama which they planted at an elevation of 2,000 feet. The lemon grass was planted at 1,600. He had just

finished the distillation of some of the grass grown at Sita Eliya and Hakgala, and the citronella grass at Sita Eliya gave 150 lb. fresh material, from which he obtained 8 lb. of oil of good quality.

Mr. WINTER : The outturn per acre seems rather small.

Mr. WRIGHT : The yield which you get at Peradeniya is usually 50 to 70 lb. per acre of citronella oil.

Mr. WINTER : I think you plant wider than we do.

Mr. WRIGHT : We have adopted the distance of two to three feet.

Mr. WINTER : Two feet is quite enough.

In reply to a question as to the return from lemon grass, Mr. Wright said he could not give the figures off hand, but they could calculate for themselves—20 lb. of oil per acre and taking the market value. As to the cost of production Mr. Winter could, perhaps, tell them better than he could.

Mr. WINTER : It depends on whether you clear the land for the cultivation of lemon grass only or for another purpose, in which case the cost would be small.

Mr. WRIGHT : In the Southern Province you will find it grown as a catch crop with rubber. It grows very quickly and covers up the ground, so that it is almost impossible for weeds to grow. We never weed lemon grass here, except after cutting it, once in every three or four months.

CITRONELLA IN 1839.

In connection with Mr. Herbert Wright's lecture on lemon grass Mr. Winter showed a document, containing an extract from some notes written by his grandfather, Mr. George Winter, in 1839, on lemon grass in Ceylon, being interesting as showing that attention was being paid to the grass in Ceylon as far back as that. The extract is as follows :—

"Lemon grass, called *nardus* by some, or spikenard. I have not found any of the grass from which this is made growing wild on the Island, but on the coast of India it is in some places very abundant. The price here, wholesale, is 6*d*. per ounce. *Citronella*—the description of grass from which this is made—I have found in the Morawak korale of this district, and first drew oil from it in 1839, when the manufacture has so much increased that the sale of it exceeds, in London, £3,000 per annum. It is said ottar of roses is adulterated by it. Price one shilling per ounce."

A quantity of the fresh grass was then placed in the receiver and distilled ; the oil refined, filtered, and bottled.

A lecture on citronella grass was also arranged for, but owing to unforeseen circumstances was not delivered. No

one present had had any experience of tapioca as a catch crop, so this also was omitted. Mr. Bamber, however, gave a lecture on camphor, a product exciting a good deal of interest in Ceylon at present.

Camphor.

By Mr. M. KELWAY BAMBER.

In the refreshment room of the Exhibition Buildings at Peradeniya, Mr. M. Kelway Bamber, of the Royal Botanical Gardens, delivered a most interesting and instructive lecture on Camphor. Dr. J. C. Willis presided.

Mr. BAMBER said: Camphor was known to Eastern nations for many centuries, India and China being the first to manufacture the drug, but Chinese export little now. The chief country from which camphor is now obtained is Formosa, where the tree forms one of the main objects of interest in the vast forests covering the mountainous portions of the island. These forests are occupied entirely by different types of savages who, in former years, and even now, strenuously oppose the Chinese camphor workers, when they attempt to further penetrate into their territory, so that the supply of camphor largely depends on the extent to which the Japanese, the present owners of the island, can protect the Chinese in their work, many hundreds of these having been killed. Here Mr. Bamber remarked that, in a previous paper which he read on the same subject at the Agricultural Board Meeting in May last, he described the method at length, in which the Chinese distilled camphor. The method of obtaining the drug by the Chinese necessitates the destruction of the trees, which are never replaced, although during my visit to Formosa in 1904, the question of planting camphor was being considered by the Agricultural Department. In the 16th century the camphor forest extended down to the plains, and, as recently as 1868, camphor trees were growing on the lower ranges of the hills in the north now given over to the cultivation of tea and other staples. From 1858 to 1868 certain European firms who opened business in Formosa obtained a monopoly of the camphor from the Chinese, and charged as much as $16 a picul (133⅓ lb.) for the drug, completely restraining the output; but in the latter year the monopoly was abolished with the result that the price fell to $7·80 a picul, and the consumption increased at once from 1,313 piculs to 7,637 piculs in six months. At that period the demand for camphor was comparatively limited. Some found its way to India, where it was used in religious ceremonies, but the larger part of it was

consumed in medicinal preparations, the demand for this not being expected to vary much from year to year. The low price of the drug at this period lasting for 15 years is however responsible for this comparatively large consumption at present, as its cheapness encouraged chemists to study its properties more carefully, and to utilise it in several manufactures which are now firmly established, but which would probably not have been so had the old or present high rates prevailed. As the demand increased the savages were gradually driven back into the interior, and the border lands rapidly became denuded of trees, so that at the present day the difficulties of obtaining the drug, transport, &c., are much enhanced, there being no roads or easy means of communication. In 1875 the export at that time of over 14,000 piculs decreased by half owing to the extraordinary activity on the part of the savages, which made it impossible to obtain the necessary supply of chips. Until 1880, the export again increased to 12,335 piculs, but from this date it rapidly fell away until, in 1885, only 3 piculs (400 lb.) were exported owing to the increased warfare between the Chinese and savages, which at this time extended from one end of the island to the other along the whole mountain border. Although the fighting quieted down for the next few years, there were frequent raids up to the time of the Japanese occupation. About 1882 the Chinese Government created a fresh monopoly with the result that the price again rose to $20 a picul, and the export for the years 1887 to 1889 amounted to only 4,000 piculs. About this time chemists discovered the value of camphor as an ingredient for several useful inventions, such as celluloid, smokeless explosives, fireworks, &c., and in 1889 it was thought that the demand for camphor would be so great to supply these new wants that the market price rose about 100 per cent. In 1891, the monopoly was again abolished and a tax of $18 per picul imposed to defray the expenses of the military stationed in the savage border. This was subsequently reduced and changed to $8 per stove of ten jars, and a likin duty of 57 cents a picul became payable when the camphor was transported. As in 1869, the abolition of the monopoly was marked by a great increase in the exports, the figures reaching 18,881 piculs for the unrestricted trade in 1891 against 7,242 piculs for 1890. In 1895 American refiners were bidding as high as $50 gold per cwt. without success, and refined camphor was quoted in the New York market at 65 cents gold per lb. in barrels and cases, but by May, 1896, it had fallen to 46 cents per lb., the export for the Island for the year exceeding 52,000 piculs (6,916,000 lb.), the largest in the history of the trade.

It has been found that the tree seems to grow best on moderate slopes at elevations not exceeding 4,000 ft. where the soil is well drained and consists of a rich vegetable mould and where the sun's rays can reach them. Little is known as to area of forests in which the camphor tree is found, but according to a Japanese estimate it is expected to reach over 1,500 square miles in extent. The manufacture is, however, limited to a comparatively small area in the north owing to either difficulties of transport or the too powerful opposition of the savages. On the lower hills few camphor trees are seen in the dense jungle, but higher up an occasional giant camphor tree appears, increasing in numbers as the actual camphor area is approached, but never monopolising the forest. Camphor trees of various sizes are fairly numerous, but big trees, such as the camphor workers most desire, are found only here and there, sometimes only a few rods, and again a third of a mile or more apart. They attain an enormous height and girth in Formosa, trees being frequently seen with a girth at base of 25 ft. or even 36 ft., and some have been observed which have required a 40 ft. line to reach round them. The camphor tree forms a fine straight bole so that the actual size indicated by the measurements can be imagined. It is one of the handsomest trees in existence: a tree 40 ft. in circumference would afford sufficient chips to keep a single Chinese distilling stove supplied with material for several years, and would yield several thousand dollars worth of camphor. Trees of average richness, measuring 20 ft. round, which are often met with, would supply a stove for some two years, and at the present price of camphor yield several thousand rupees worth of the drug. The trees from which most of the camphor is obtained measure some 12 ft. in circumference, and yield something over 50 piculs of crystallised camphor – 6,665 lb. or nearly three tons. Although depletion has gone on for many years, and the difficulties of obtaining the drug are in some ways enhanced, it is stated that the supply of camphor trees in Formosa is still sufficient for the needs of the whole world for the next century, even if the past rate of depletion continued, which, under the Japanese Government, is not likely to be permitted, and the land will no doubt be re-afforested with this important tree.

Owing to the high price of camphor and the increased demand during the last ten years, several countries have experimented with the growth of the tree, and it has been found that it can accommodate itself to a very wide geographical range with varying conditions of soil and climate. Among the countries in which it is being satisfactorily cultivated are Italy, South-east France, California, South Carolina, Florida,

Madagascar, Brazil, Egypt, Ceylon, India, the Canary Islands, and several other countries. Even China, which of late years had practically ceased the manufacture of the drug, recommenced operations, camphor trees of 24 ft. to 28 ft. in circumference having been found in abundance in the Central and Southern Provinces of Chekiang, Kwangsi, and Fokien. As regards the rate of growth and yield in some of these countries, it is given for America as an average height of 30 ft. and a girth of 30 in. in ten years from seed, and in Florida trees less than twenty years old have yielded about $1\frac{1}{2}$ per cent. of the crystallised product from the leaves and twigs, this being practically identical with the yield in Ceylon even from bushes of three to five years old. There are over two thousand stoves of ten jars each in Formosa. The old Chinese stoves, which have turned out an enormous quantity of camphor, were simple small wooden casks on perforated boards over an iron pan built into clay fireplaces, and connected by a bamboo pipe, with the condensers of wood. Each retort was 20 in. high. 1 ft. diameter at the bottom, and 7 in. at the top, and was heavily lined with clay, and ten of these were arranged on a furnace to form a stove. Each held 12 to 13 lb. of chips about 1 in. in length, and slow distillation continued throughout the night, when from an opening in the side of the retort the lower half of the chips were removed and fresh chips added from above, the still closed, and distillation continued. This refilling took place twice in the 24 hours, and after ten days the jars or boxes are removed and the camphor is detached by the hand and packed away; the quantity obtained per jar varies with the skill of the labourer and the richness of the chips in the drug, from 5 lb. to 7 or 9 lb., for which the Chinaman gets $12 a picul, which price includes the transport. Japanese stoves and condensers of an improved construction on the lines shown at the Nuwara Eliya Show are now employed with more satisfactory results as to the saving of time and increase of yield. Their retorts now hold about 400 lb. of chips, which are well packed in, which are changed once every twenty-four hours, about 28 gallons of water being distilled in carrying over the camphor. Hard water is found to be better than soft. After ten days the fire is extinguished, the apparatus allowed to cool twenty-four hours, and the camphor removed.

The average yield is about 8 to 9 lb. per day of distillation though it has been known to run as high as 17 to 18 lb. It will thus be seen that the average percentage of crude camphor equals $2\frac{1}{3}$ per cent. One stove has yielded 5 per cent. The camphor is placed in tubs provided with an outlet from which camphor oil drains to the extent of 50 per cent.

containing, however, 50 per cent. of camphor, which can be obtained by freezing and centrifrugalising or pressing. Yield and proportion of oil varies with season—there is more oil in summer. The Chinese stove is superior as regards proportion of camphor to oil; possibly the Japanese steam supply is too low. The steam must not come in contact with metal. The camphor tree of Formosa is said to be richer in the drug than that of Japan, and poor, sunny soil gives more camphor in the wood, but individual trees vary much grown side by side, so that selection would be advisable.

Professor Moriya, of the College of Agriculture Imperial University, gives the following data of its composition :—

	Per cent.
Twigs	2·21
Branches	3·30
Upper part of stem	3·84
Lower ,, ...	4·73
Upper part of stump	5·49
Lower ,, ...	5·77
Root	4·46
Average	4·22

Wood, giving only 2 per cent. by the ordinary model, gave 10 to 15 per cent. of oil with an improved still of his own design.

The following description of the various camphor oils and their constituents will be of interest :—

SAFROL.—C_{10}, H_{10}, O_2 found in oil of camphor, called Sassafras. When pure it is a white crystalline mass at low temperatures, melting at 8° C. At ordinary temperatures it forms a colourless oil of pleasant odour, of sp. gr. about 1·1, and boiling at 230° C. It is optically inactive when pure. It is used in an enormous extent for perfuming cheap soaps, and is also of great commercial value for the production of an artificial perfume, "Heliotropin," by oxidation.

CRUDE CAMPHOR OIL.—Yellow in colour, sp. gr. 0·950 to 0·995. Camphor can be removed from it by reducing the temperature of the oil, as much as 26 lb. from 40 gallons being recovered. It can also be obtained by fractional distillation, the third and sixth fractions containing most. By this means 40 gallons of oil have yielded 78 lb. of camphor, and a portion of the fractionated oil has a blue tint, and possesses insecticidal properties.

WHITE CAMPHOR OIL.—This is obtained from crude camphor oil from fractional distillation of the crude oil after the separation of the camphor. It is colourless and transparent. Sp. gr 0·87 to 0·91. It boils from 150 to 190° C. and deposits no crystals when cooled to 20° C.

Red Camphor Oil is the fraction from the crude oil obtained after the white oil. It is a brown liquid, sp. gr. 1·001 to 1·035. It boils between 225 and 270° C, and consists chiefly of safrol, a little eugenol, and a trace of camphor. The red oil is fractionally distilled, the fractions boiling at about the boiling of safrol, that is 230 to 235° C, being collected apart. From these it is separated by freezing, and purified by re-crystallisation. The yield from the red oil of sp. gr. 1·0165 is about 21 per cent. It crystallises in colourless prisms and rhombic prisms which melt at about 12° C to a colourless liquid of the sp. gr. 1·107 at 15° C, and solidifies at — 20. Commercial specimens of safrol range in sp. gr. between 1·104 and 1·1065.

The Discussion.

Mr. Ryan wished to know what became of the residual leaves after distillation.

Mr. Bamber said that they could be used as manure.

Mr. Ryan then remarked that he was given to understand by Mr. Hunter that in places where camphor leaves were spread the weeds did not grow—in fact that little else grew in camphor clearings.

Mr. Turner said that the majority of the camphor trees he had seen abroad resembled laurels. He wished to know the age of the oldest camphor trees in Ceylon.

Mr. Bamber said that the trees in Hakgala were planted in 1895. (Trees were introduced at Peradeniya in 1852.)

Mr. Ryan said that he saw a very old camphor tree at Hakgala some twenty years ago when Mr. Nock was in charge of the place.

Mr. Carruthers said that he wished to ask Mr. Bamber about a practical method of dealing with camphor as a catch crop, as they were all in search of catch crops. He also wished to know whether it was not more expensive having teak stills, as the ones out in the machinery shed did not seem to be vested with long life, and considering that they cost Rs. 150 he thought that metal stills would be more economical.

Mr. Bamber pointed out that copper stills would cost as much as Rs. 3,000 or Rs. 4,000, whereas iron ran the risk of being eaten through by the acids in a comparatively short time. The camphor plant could be made to pay in three years' time. He had distilled with young plants, and the results were fairly satisfactory. He took the opportunity of warning those present that there should be a limit to the camphor output, as the price from 355 shillings a cwt. would

in all probability drop as supplies increased. The cost was about 60 shillings a cwt. Although there was a wide margin, the area planted with this product should be limited. The drug was very variable in price. As a catch crop it could be made to pay in two or three years.

Mr. CARRUTHERS said that in the Federated Malay States there were only a few trees ranging from 2 to 2½ years. These were exposed to the sun, and they were about 6 ft. high and they seemed healthy. He suggested camphor as a catch crop merely to get over the hard times till the rubber began to pay.

Mr. WELLDON : Can you tell me the difference in the results of yield of camphor from up-country and low-country ?

Mr. BAMBER said those from Galle gave 1·5 per cent., while the up-country gave 1·7 per cent. Some low-country camphor was as good as up-country. The Peradeniya camphor, however, was very poor. The rainfall in Formosa at its best was from 80 to 100 inches, and it was similar to Hakgala.

Dr. WILLIS remarked that there was a difficulty in securing seed. They had got their seed hitherto from Japan, and he feared that if an application was made for a very large quantity of seed they would stop it altogether. He said that if Ceylon planted 10,000 acres it would make a very serious difference in the price.

Mr. BAMBER said that originally camphor growers depended mainly on seed, but now they could raise plants from cuttings. The soil needed to grow camphor was a fairly sandy one.

Mr. ZACHARIAS said that Mr. Petch, in his lecture on Tuesday evening, said that the rubber planters should divide their estates with belts, so he thought that camphor would make excellent belts.

Mr. BAMBER said that it was a very good idea. The camphor trees had their branches low down, and together with some taller trees they would make good protecting walls.

Mr. CARRUTHERS : I wish to know how long it would take to grow to form a good barrier. What was needed was a plant that grew up quickly, as they might otherwise run the whole gamut of diseases before the camphor became a real protection.

Mr. GREEN said that camphor was an excellent undergrowth.

Mr. CAMERON asked the lecturer if he could suggest a cheap weed-destroyer. He heard Mr. Ryan speak about the destructive powers of the leaves, so he wished to know if the lecturer thought that the camphor leaf would answer.

Mr. BAMBER said that the large amount of tannin in the leaves of the camphor tree was unhealthy to weeds. Those present were shown samples of camphor and Mr. Bamber's still.

PARA RUBBER KNIVES.

CHAPTER V.

THE TAPPING KNIVES.

LIST OF ENTRIES.

COLLECTING APPARATUS.

1. Best Instrument or Series of Instruments for Tapping Para Rubber Trees : (*a*) Paring ; (*b*) Pricking.

TWO GOLD MEDALS.

Beling, E. H., St. Andrew's, Kalutara. Two exhibits.
Bowman, E. D., Baddegama estate, Baddegama. (2)
Brown & Davidson, Talawakele.
Cameron Bros., Monte Christo, Nawalapitiya. (2)
Colombo Commercial Co., Colombo.
Dingi Baba Baas, Matale.
Holloway, Francis J., Kepitigalla, Matale.
Macadam, C. O., and Miller, W. T., Culloden estate.
Macadam, C. O., Culloden estate, Neboda (*a*, two exhibits ; *b*, one exhibit).
Northway, C., Deviturai, Elpitiya.
Pask, G. W., Kepitigalle estate, Matale. (2)
Rubber Plantations Co., Ltd. (Martin, J. R.), Hylton, Matale.
Smith-Robson, care of George Robson & Co., Colombo.
Sturgess, G. W., Colombo. One set of 2 knives.
The Fairfield Iron Works, Slave Island, Colombo. (4)
Tisdall, W. N., Vogan estate, Neboda.
Toller, C. H. M., Oolapane estate, Ulapane.
Walker, H. E., Ingoya, Watawala.
Westland, J., Gammadua Group, Gammaduwa. (2)

2. Best Instrument or Series of Instruments for Tapping Castilloa Trees.

GOLD MEDAL.

Beling, E. H., Kalutara.
Bowman, E. D., Baddegama estate, Baddegama. (2)
Brown & Davidson, Talawakele.
Cameron Bros., Monte Christo, Nawalapitiya.
De Hoedt, V. W., Coodoogalla, Kadugannawa.
Dingi Baba Baas, Matale.
Lewis Brown & Co., Colombo.
Macadam, C. O., Culloden, Neboda. (2)
Northway, C., Deviturai, Elpitiya.
Sturgess, G. W., Colombo. One set of 2 knives.
The Colombo Commercial Co., Ltd.
The Fairfield Iron Works, Slave Island, Colombo. (2)

3. Best Instrument or Series of Instruments for Tapping Ceara Trees.

GOLD MEDAL.

Beling, E. H., St. Andrew's estate, Kalutara. (2)
Bowman, E. D., Baddegama estate, Baddegama. (2)
Brown & Davidson, Talawakele. (4)
Cameron Bros., Monte Christo, Nawalapitiya. (4)
Dingi Baba Baas, Matale.
Lewis Brown & Co., Colombo.
Macadam, C. O., Culloden, Neboda.
Northway, C., Deviturai, Elpitiya.
Sturgess, G. W., Colombo. One set of 2 knives.
The Colombo Commercial Co., Ltd.
The Fairfield Iron Works, Slave Island, Colombo. (2)
Toller, C. H. M., Oolapane estate, Ulapane.
Westland, James, Gammadua Group, Gammaduwa. (2)

4. Best Instrument or Series of Instruments for Tapping Rambong Trees.

GOLD MEDAL.

Brown & Davidson, Talawakele.
Cameron Bros., Monte Christo, Nawalapitiya. (4)
Dingi Baba Baas, Matale.

Lewis Brown & Co., Colombo.
Northway, C., Deviturai, Elpitiya.
Sturgess, G. W., Colombo. One set of 2 knives.
The Colombo Commercial Co., Ltd.
The Fairfield Iron Works, Slave Island, Colombo. (2)

5. Best Instrument or Apparatus for Tapping high parts of Trees.

GOLD MEDAL.

Holloway, R. J., Kepitigalle, Matale.
Sturgess, G. W., Colombo. One set of 2 knives.

JUDGES' REPORT UPON THE TAPPING KNIVES.

A.—PARA RUBBER KNIVES.

The judging of these knives was a matter of some considerable difficulty, and the careful examination of all the many knives exhibited, and which showed a great variety in form, took several days.

As showing the characters upon which we laid stress, the following list, with the marks allotted to each, will be of interest, and will help those engaged in designing knives for this purpose.

The primary division of marks was into four heads, as follows :—

	Marks.
I.—Thinness of Paring	250
II.—Convenience and Facility in Operation ..	500
III.—Suitability for both Opening and Paring ..	50
IV.—Simplicity and Durability	200
	1,000

These heads were then subdivided as follows :—

I.—Thinness of Paring.	Marks
(*a*) Uniformity of section	70
(*b*) Control of section (efficiency of guard) ..	70
(*c*) Cleanness of cut (absence of drag) ..	70
(*d*) Adjustability	40

II.—Convenience and Facility in Operation.	Marks.
(*a*) Muscular effort required	110
(*b*) Visibility of cut during operation	50
(*c*) Capability of cutting in all directions (*i.e.* up or down, right or left)	100
(*d*) Absence of clogging	50
(*e*) Suitability for unskilled labour	100
(*f*) Prevention or impossibility of incorrect use by cooly	90

III.—Simplicity and Durability.

(*a*) Price	40
(*b*) Length of life	40
(*c*) Retention of sharpness	40
(*d*) Facility for sharpening	40
(*e*) Lack of complication	40

Every knife was then carefully put through a test as to its qualities under all these heads, and whenever possible was demonstrated to the judges by its maker or designer, or some-one deputed by him.

It would be invidious to give the actual marks earned by the different knives, but we may mention that the Bowman-Northway and the Miller knives obtained about 750 each, and were so near together that both were awarded Gold Medals.

Prize Winners.

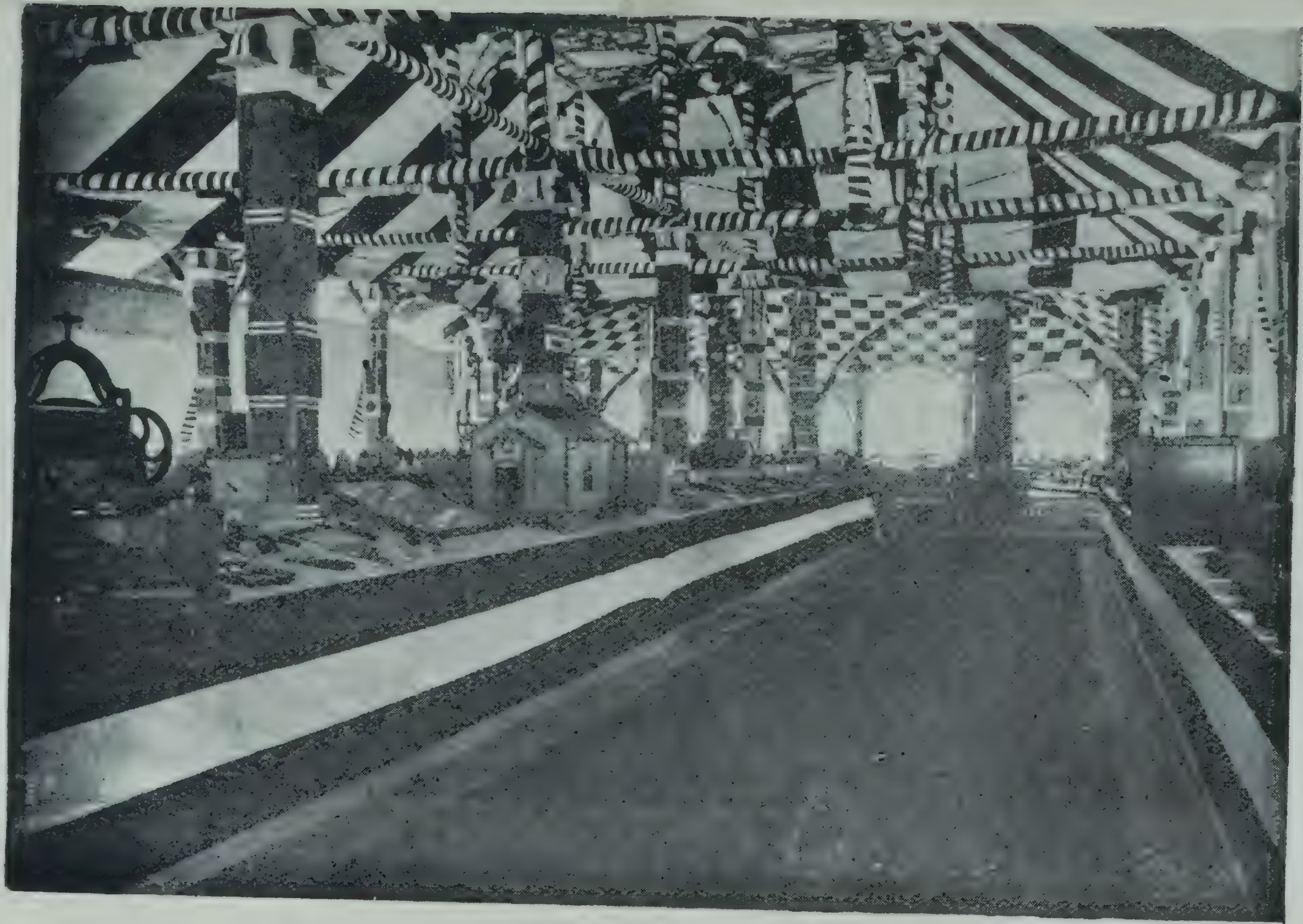
Best Instrument or Series of Instruments for Tapping Para Rubber Trees.

(*a*) PARING.

Bowman-Northway Knife, Miller Knife	.. Gold Medals.
Wynn-Trimmins Knife	.. Silver Medal.
Cameron Bros. Knife	.. Honourable Mention.
Tisdall Knife	.. Mention.

Knives for other kinds of Rubber Trees.

With regard to the instruments for tapping other species of rubber there is but little to record. The great majority of the instruments shown were simply Para rubber tapping knives entered in the other classes, and this is by no means what is required. Neither Castilloa nor Ceara rubbers will stand the treatment that Para rubber stands, without injury, and their barks are of a different quality and consistency. So far as we know at present, the Castilloa tree, for instance,



TAPPING INSTRUMENTS, RUBBER TOOLS, &C. *Block by Survey Dept.*

requires simply one opening cut, and then pricking, and the Ceara tree very simple and careful handling. Invention should be brought to bear upon the special problems presented by these trees.

(*b*) PRICKING.

Gold Medal	..	(No award)
Silver Medals	..	Messrs. Bowman and Northway C. O. Macadam

2.—Best instrument or series of instruments for tapping Castilloa trees. Gold Medal—C. O. Macadam.

3.—Best instrument or series of instruments for tapping Ceara trees. Gold Medal (not awarded). Silver Medal—C. O. Macadam.

4.—Best instrument or series of instruments for tapping Rambong trees. No award.

5.—Best instrument or apparatus for tapping high parts of trees. No award.

J. B. CARRUTHERS.
CUTHBERT CHRISTY.
M. KELWAY BAMBER.
JOHN C. WILLIS.

The following remarks of the Secretary, Planters' Association, Federated Malay States, may also be quoted :—

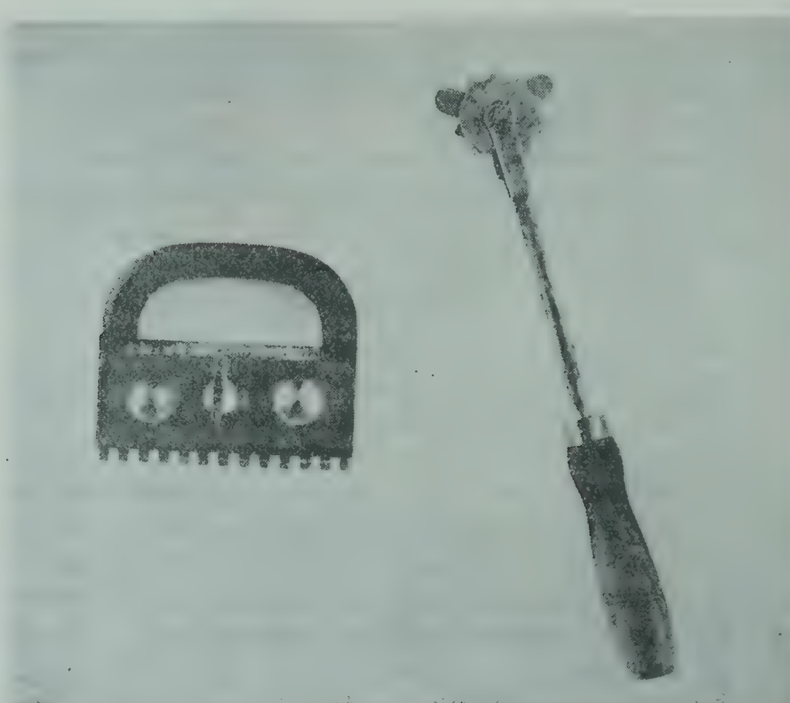
All paring knives awarded a prize were really constructed on the same principle and only varied in its application, viz., a guard so regulating the paring blade as to prevent it cutting too deep. The simplest, and therefore perhaps best of all, was the Miller parer, which is absolutely solid and has no moving parts at all. The Bowman-Northway has a sliding guard, which however requires no screws for adjustment. The Trimmens, Cameron, and Tisdall are all fitted with screw adjustments, but whilst in the first the parer, in the case of the latter two, the guard is adjustable. There was yet another tapping instrument, which, whilst not exhibited at the Show, was shown in working at the Henaratgoda demonstration. This, the Srinivasagam Patent, is something between the Miller and Bowman-Northway parers. It gave very good results at Henaratgoda and combines the use of a knife for the first incision with that of a parer for subsequent tappings.

Of prickers, which in importance seemed destined to soon outshine all knives and parers, the Macadam comb-pricker easily comes first as a most promising tool, the usefulness of

which might perhaps be enhanced by slightly curving it. The Bowman-Northway is the customary spur-wheel with a triangular guard.

The instrument of Mr. C. O. Macadam's, which received the Gold Medal as instrument for tapping Castilloa and the Silver Medal for tapping Ceara, is the ordinary knife used for making first incisions. There is no doubt that the proper method of tapping Ceara has yet to be discovered, the present great trouble experienced in obtaining the latex without injuring the tree being mainly responsible for restricting the cultivation of this otherwise excellent Rubber Plant.

It will be particularly interesting to those members, who own Rambong areas, to note that the Judges were unable to give any awards to apparatus entered for tapping Rambong trees; whilst the tapping of high parts of trees (also no awards made) is really of academical interest only—From Report of Delegates to Ceylon Rubber Exhibition, p. 7.



1. MACADAM PRICKER. 2. BOWMAN-NORTHWAY PRICKER.

CHAPTER VI.

MACHINERY FOR THE TREATMENT OF LATEX, OR RUBBER.

WE may now pass on to the question of machinery, a question which is daily becoming of greater importance, for it is becoming evident that primitive hand methods are unsuited to dealing with the very large quantities of latex that are beginning to come in on the older estates. So far, as will be seen from the report of the Judges, the machinery produced is in the earlier and more primitive stage, and many improvements will have to be made in it; but these, with the invention and ingenuity now being applied to it in all quarters, will doubtless soon be accomplished.

We shall commence with a general account of the whole lot of the machinery, given by Mr. Wright, and pass on to the more specialised details later.

The list of machinery other than tapping knives, for which prizes were offered, and the entries follows :—

6. Best Apparatus or Method for assisting the Flow of Latex from Rubber Trees.

GOLD MEDAL ; SILVER MEDAL.

Bird, W. J., Duckwari estate, Rangalla.
Brown & Davidson, Talawakele.
Leichsenring, H. R., Grossenhain, Germany.

Silver Medal—Brown & Davidson, Talawakele.

7. Best Apparatus or Method for centralizing the Latex from separate Trees.

GOLD MEDAL.

Brown, G. S., Talawakele.
Walker, Sons & Co., Ltd., Colombo.

No award.

8. Best Apparatus or Method for Storing Latex in a good and uniform condition before Coagulation.

GOLD MEDAL.

Brown & Davidson, Talawakele.

No award.

9. Best Sample of Preserved Liquid Latex of not less than 4 gallons.

GOLD MEDAL.

Heatherly Estate (J. Farley Elford), Neboda.

No award.

10. Best Apparatus or Method for determining the amount of Acid required for coagulating Latex.

GOLD MEDAL.

No entries.

11. Best Method of coagulating Latex to marketable Rubber, whether by Acid, by Decay, by Smoking, or otherwise.

GOLD MEDAL ; SILVER MEDAL.

Bird, W. J., Duckwari estate, Rangalla.
Brown & Davidson, Talawakele. (3)
Holloway, Francis J., Kepitigalla, Matale.
Walker, Sons & Co., Ltd., Colombo.

Gold Medal—Walker, Sons & Co. Ltd., Colombo.
Silver Medal—W. J. Bird, Duckwari estate, Rangalla.

12. Best Apparatus or Method for removing Mechanical Impurities in freshly coagulated Rubber.

GOLD MEDAL.

Brown & Davidson, Talawakele. Two exhibits.

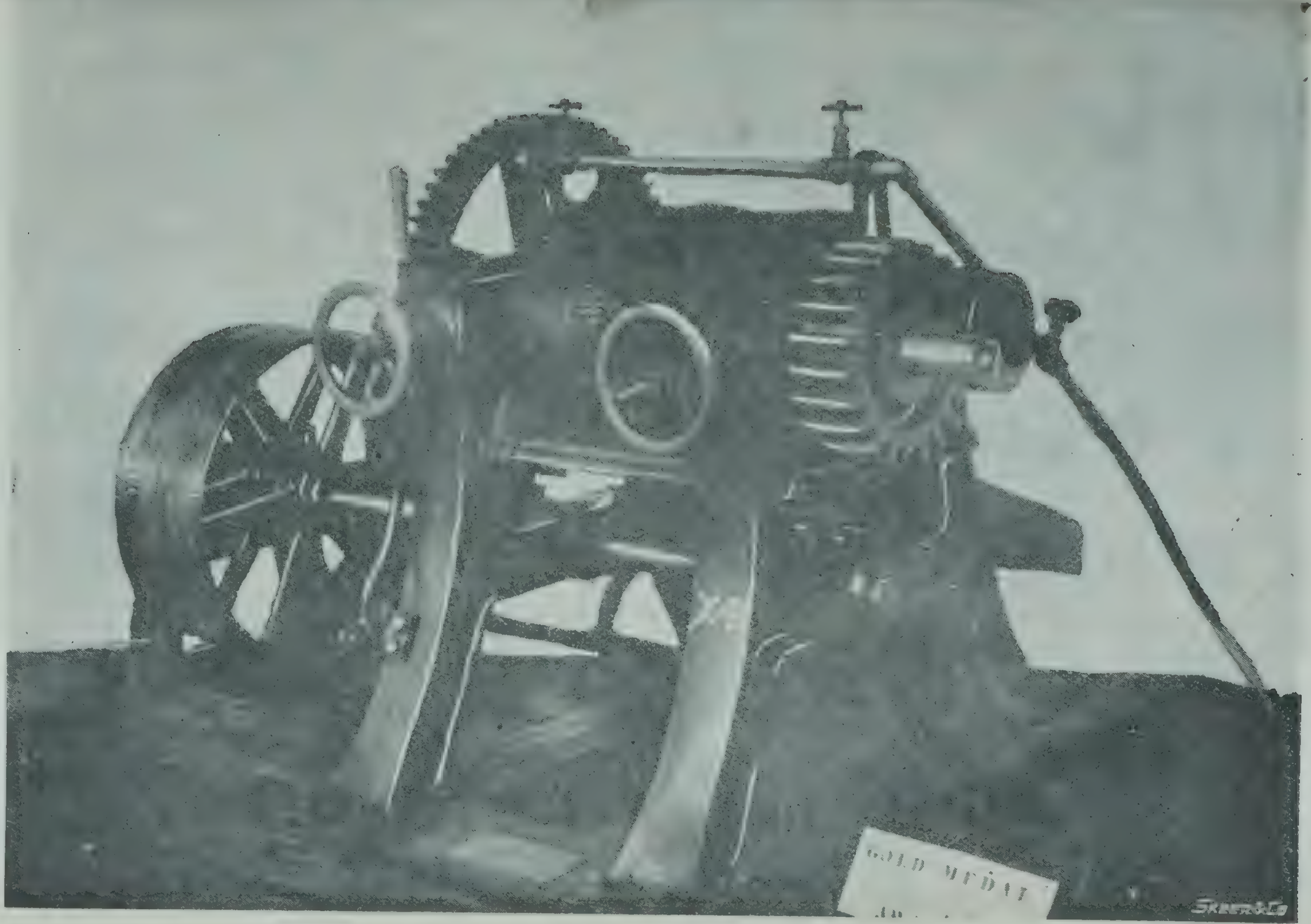
Gold Medal—Brown & Davidson, Talawakele. (2)

13. Best Apparatus or Method for expelling Water from freshly coagulated Rubber.

GOLD MEDAL.

Brown & Davidson, Talawakele.

Gold Medal—Brown & Davidson, Talawakele. (2)



MESSRS. BROWN & DAVIDSON'S COMBINED MACERATING AND CREPE RUBBER MACHINE.

14. Best Apparatus or Method for preventing Putrefaction of Rubber.

GOLD MEDAL.

Brown & Davidson, Talawakele. (2)

Gold Medal—Brown & Davidson, Talawakele. (2)

15. Best Apparatus or Method for drying Rubber.

GOLD MEDAL.

No entries.

16. Best Apparatus or Method for recovering Rubber from Bark Shavings.

GOLD MEDAL.

Brown & Davidson, Talawakele. (2)

17. Best Macerating Machine for obtaining Rubber from Twigs, Leaves, or Prunings of Rubber Plants.

GOLD MEDAL.

Brown & Davidson, Talawakele.

Gold Medal—Brown & Davidson, Talawakele, Ceylon. (2)
Silver Medal—Federated Engineering Co., Kuala Lumpur, Federated Malay States.

18. Best Rubber-washing Machine.

GOLD MEDAL.

Brown & Davidson, Talawakele.
Walker, Sons & Co., Ltd., Colombo.

Gold Medal—Brown & Davidson, Talawakele.
Silver Medal—Federated Engineering Co., Kuala Lumpur, Federated Malay States.

19. Best Apparatus or Method for protecting the Tree during Tapping Operations.

GOLD MEDAL.

Cameron Bros., Monte Christo, Nawalapitiya.
Grigson, E. F., and Forsythe, W., Sunnycroft, Ruanwella, and Glanrhos estates, Neboda. (2)

No award.

20. Best Model of Curing-house or Curing Apparatus.

GOLD MEDAL.

Bamber, M. Kelway, Colombo.
Brown & Davidson, Talawakele.
Grieve, J., care of Brown & Co., Ltd., Colombo.
Macadam, C. O., Culloden estate, Neboda.

Gold Medal—M. Kelway Bamber, Colombo.

21. Best Method of Packing Rubber for export.

GOLD MEDAL.

Botanic Gardens, Singapore.
Pears, F., Lanadron estate, Muar, State of Johore.
Ryan, James, Talawakele.

No award.

22. Best Method of testing Resiliency and other qualities of prepared Rubber.

GOLD MEDAL.

No entries.

23. Best and most promising Method of vulcanizing, hardening, or colouring Rubber.

GOLD MEDAL.

Bamber, M. Kelway, Colombo.

Gold Medal—Specially awarded to Mr. Kelway Bamber for object of great interest.

24. Best Machine for uprooting Stumps of Trees.

GOLD MEDAL.

Brown, G. S., Talawakele. (A Plan.)

No award.

25. Best Method of destroying Stumps of Trees.

GOLD MEDAL.

No entries.

A Demonstration of Rubber Machinery.

By Mr. Herbert Wright.

The demonstration took place in the two engine sheds.

Mr. Wright said : Gentlemen,—We are present here this morning to go through a series of practical demonstrations, the object of which will be to show you the various types of machines sent into the Exhibition by different exhibitors from various parts of this Island, as well as from the Straits and from the Federated Malay States. I think we all feel very grateful to the engineering people who have spent so much time, thought, and trouble, to help to make the collection of rubber machinery such a complete one. I think we may safely say, without fear of contradiction, that this is the first time that such a complete series of machinery and apparatus has ever been brought together and shown in connection with the storing, coagulating, curing, smoking, washing, and blocking of rubber. In these rooms we have the advantage of seeing every process, from the tapping of the rubber trees to the preparation of the rubber in blocks ready for transport to the market. I propose to make a somewhat hasty review of the machinery that we see around us, and we may then allow this lecture to lapse into an informal discussion arising out of it.

With regard to the first operation, the tapping of the trees, I think it hardly necessary for me to go over the various systems adopted in the East, as you can see them here for yourselves ; and I hope that on Tuesday you will all visit Henaratgoda, where the various methods used will be illustrated, and where some information regarding the results obtained by the different systems will be made public.

The Centrifugal Strainer.

Assuming, then, that we have got the latex collected, and at the store in the condition in which you see it here, in this receptacle (pointing to a bucketful of latex, which seemed mixed with some foreign matter and in which were bits of straw, wood, bark, and other ingredients of what may be generally termed mechanical impurities). As you see, there is a large proportion of mechanical impurities in the latex. We must now adopt some process to remove these impurities. This apparatus—known as Macadam's Latex Strainer—is devised for this purpose. It consists of a large basin to hold the latex, and is fitted with a pipe to allow the latex to escape ;

inside is an ordinary piece of cloth arranged in the form of a bag which fits closely to the inside of the basin of the machine. We pour the latex—with all its impurities—into this bag and we set the apparatus in motion. We then see the latex issuing from a small pipe at the side of the receptacle below the basin, while all the mechanical impurities are detained by the cloth, as a result of the centrifugal motion imparted to the contents of the bag. By this means, large quantities of latex can be freed effectively and rapidly from any mechanical impurities. I think you will agree with me that this apparatus—Macadam's Centrifugal Machine—is a nice contrivance for removing mechanical impurities from latex at a rapid rate. It is possible to deal with fairly large quantities of latex in 30 to 60 minutes in this way. In this particular experiment, which I have conducted before you, you have seen that some 2½ gallons of latex have been strained perfectly in under three minutes; that is a great score over the ordinary hand or other petty methods hitherto employed, such as the use of metallic sieves, cloth bags, &c. The machine goes at approximately 3,000 revolutions per minute. If necessary, such a machine can be made to go at the rate of 10,000 or 11,000 revolutions per minute. But that is a high rate of revolution which is not really necessary.

Accumulation into Settling Tanks.

Mr. Wright and the gathering then moved on with the strained latex to the settling tanks on view, provided by Messrs. Brown & Davidson. Mr. Wright said: We have now got our latex strained and filtered in the centrifugal strainer, and we come to the next process. From the centrifugal machine, the latex can be placed in one of the settling tanks, and there accumulated until you have got a sufficient quantity of latex together to prepare on a large scale. Here you see a settling tank. This tank is supplied with a small circular drip tin, so constructed as to allow dilute ammonia or formalin to be added to the latex at the rate of 10 to 20 drops an hour. Then the plates inside the tank are turned, so that all the latex and the ammonia or formalin are thoroughly mixed with one another. This keeps the latex in a liquid condition, so that you can remove it from the centrifugal machine and place in the tanks until large quantities of it are accumulated. This settling tank was filled with latex on the 12th September and the latex remained in that condition until it was coagulated last evening. Here, in these buckets, you see the samples of the coagulated latex. This demonstration makes

THE MACHINERY SECTION. *Block by Survey Dept.*

it clear to you that latex from trees of varying ages, collected on different days or on the same day, may all be mixed together in the same tank, with the result that a uniform standard of rubber is ultimately prepared therefrom.

Smoking of Rubber.

The next step, as far as these exhibits take us, is the process of smoking the latex. In this particular case a fire is arranged behind the screen, and the wood is after being steeped in creosote, fired and allowed to smoulder. The smoke produced enters at the bottom and the middle of the apparatus and then begins to ascend along the whole apparatus. The smoke entering at the bottom passes along the surface of one baffle plate, through the air or smoke spaces, over to the next baffle plate, and so on, over a series of something like a dozen or a score of these baffle plates. The latex is poured in at the top, a sieve being there provided to remove any mechanical impurities. The latex then descends and passes over this large area of exposure on the plates and there meets with the smoke. This ensures that the particles of the latex become intimately mixed with all the smoke ingredients. Judging from the results obtained by smoking rubber, one may feel inclined to believe that the smoking internally of the latex itself—analogous to Mr. Bamber's sulphurizing of the latex instead of the rubber—will be accompanied by better results. These small samples of rubber have been prepared from latex which has been passed through the smoker five times ; you see it is discoloured and smells of creosote. Creosote, I may mention, may be added to the latex in a form of an alcholic solution before it is poured through.

Coagulation.

Having smoked the rubber, the next step in the process of preparation is the coagulation. We have here three ways of coagulating latex represented in the Exhibition. We have the apparatus known as the Michie-Golledge machine, which is an arrangement by which large quantities of latex can be rapidly coagulated in 1½ minute. The machine is well-known on account of the good work it has done. But it seems necessary to point out that, to effect coagulation, acid must be used. After the latex has been mixed with formalin or ammonia, a larger quantity of acid is required to effect coagulation. If you set the machine in motion, you will notice that there is originally a centrifugal and subsequently a centripetal action

incurred. The other method of coagulating is by using the ordinary settling tanks when the manufacture of sheet rubber is desired. To the settling tanks may be added acid of the required quantity and the rubber allowed to coagulate on the surface. The third method which you see is the ordinary method of putrefaction. The latex is allowed to accumulate, it undergoes decomposition, and acids are formed; the rubber then clots or coagulates. You will see samples of rubber which have been prepared in each of these ways.

Washing and Maceration.

The washing and macerating machinery in this Exhibition is very complete. We have two sorts of rollers from the Federated Engineering Company of Kuala Lumpur. Then we have the four simple and combined machines of Messrs. Brown and Davidson of Ceylon, all in working order. We have also a small machine from Messrs. Walker, Sons & Co. In all these machines the principle is to subject the rubber to a tearing and stretching process, and, while in that condition, to wash it with a strong current of water, either hot or cold. Some of the corrugated and fluted rollers move at the rate of 1 to $1\frac{1}{2}$; others at the rate of 1 to 2, this differentiated rate being sufficient for the purpose. When it has been thoroughly washed it may be passed through these other rollers, which are more or less smooth, and turned out in the form so familiar now—crepe. When not subjected to maceration, the rubber may be put through smooth rollers, and turned out in the form of sheet rubber. These machines will now be put in motion, and you will see how the whole work is managed.

Drying.

Having effectively washed our rubber, and having turned it out in the form of crepe or sheet, the next piece of work is to expel the water from it. This may be done by means of these smooth steel rollers, by means of a press, or in a curing house. Once the moisture is partially expelled, the complete drying can be effected either in a curing house or in vacuum chamber or in a press. There are several curing processes exhibited here, and your attention is invited to them. The vacuum chamber is simply a means of drying rubber in the shortest time by using high and low temperatures. A temperature of 120 to 130° F. is commonly used. In connection with these vacuum dryers, it has been said that the rubber is very often liable to become very soft and sticky. Most of us have been

informed that it was the occurrence of this phenomenon which led to the introduction of block-rubber by Mr. F. Pears of the Federated Malay States. We have been assured that the preparation of block rubber in association with vacuum chambers can, perhaps, only be done when dealing with rubber other than ordinary scrap. This softening of the rubber has been attributed by many manufacturers at home to the fact that the rubber has been left in the vacuum chamber *after* the moisture has been extracted from it, and they inform us that if the rubber is only allowed to remain in the vacuum chamber until it is nearly dry, it will not become soft.

Crepe Rubber.

Crepe rubber seems to find favour among many manufacturers. Among the judges it is commonly agreed that crepe is a form which one can guarantee to turn out on the London market free from mould or tackiness. In the case of biscuits or sheet, mouldiness and tackiness are now of frequent occurrence. The judges do not know of any case where crepe rubber prepared from freshly coagulated rubber has shown any such characteristics. I should mention, however, that when crepe is made from rubber bark or shavings from crepe rubber, this freedom from liability to tackiness does not hold good, and you can see from the sample here that when the crepe has been made by macerating the bark shavings or fragments from the rubber, the final product is discoloured and very often sticky on the surface and very soft.

In making crepe, the freshly coagulated rubber is masticated and the rubber made to present an uneven and increased surface. This allows the moisture to escape all the more rapidly. To minimize the liability to become mouldy, in consequence of this enormously increased surface, the crepe is subjected to a process of washing, and any soluble impurities are removed ; bacteria, essential for the production of tacky rubber, will thus not find the necessary sustenance. The grooved and fluted rollers naturally move at uneven rates in order to effect the stretching of the rubber.

Block Rubber.

Lastly, we come to the making of block rubber for the convenience of export. We have got our manufactured rubber, and we must consider how it can be blocked to minimize the cost of transport. When freight is charged according to cubic capacity, it is obvious that, wherever economy can be shown, it will be greatly to the advantage of the planters, living as they do so far from Europe. The crepe

at this stage can be blocked at once or it can be placed in vacuum dryers and when almost dry, folded or arranged in layers and put in this block press. This press is a somewhat powerful one, and the prize block from Lanadron estate was yesterday made to bulge by the enormous pressure of several tons to the square inch which was placed upon it. We have made two small blocks of rubber this morning, and the effectiveness of the process will be impressed upon you when I tell you that several loose sheets were folded over and placed in the block and, after three minutes pressure, removed. The sample of block rubber thus prepared shows the layers very distinctly. That is very encouraging, the compression having been made satisfactorily. Another small block has been made from a series of Ceara rubber biscuits and is quite equal to the other sample just shown to you. I may add, in passing, that it is much easier to block rubber when it is partially dry and in a relatively soft state than when perfectly dry and tough.

Mr. WRIGHT then showed the gathering some samples of rubber prepared from the settling tank, and demonstrated the process of washing crepe. A sample of sheet rubber was also shown and bark shavings, smoked latex, &c., one feature of the lecture was that, within the space of time taken by the demonstration, latex accumulated during the past 12 days was put through the various processes beginning with the centrifugal machine and ending practically with the making of a block.

A question was asked by one of those present as to how the crepe rubber was so shaped in pieces as to exactly fall in with the size of the block.

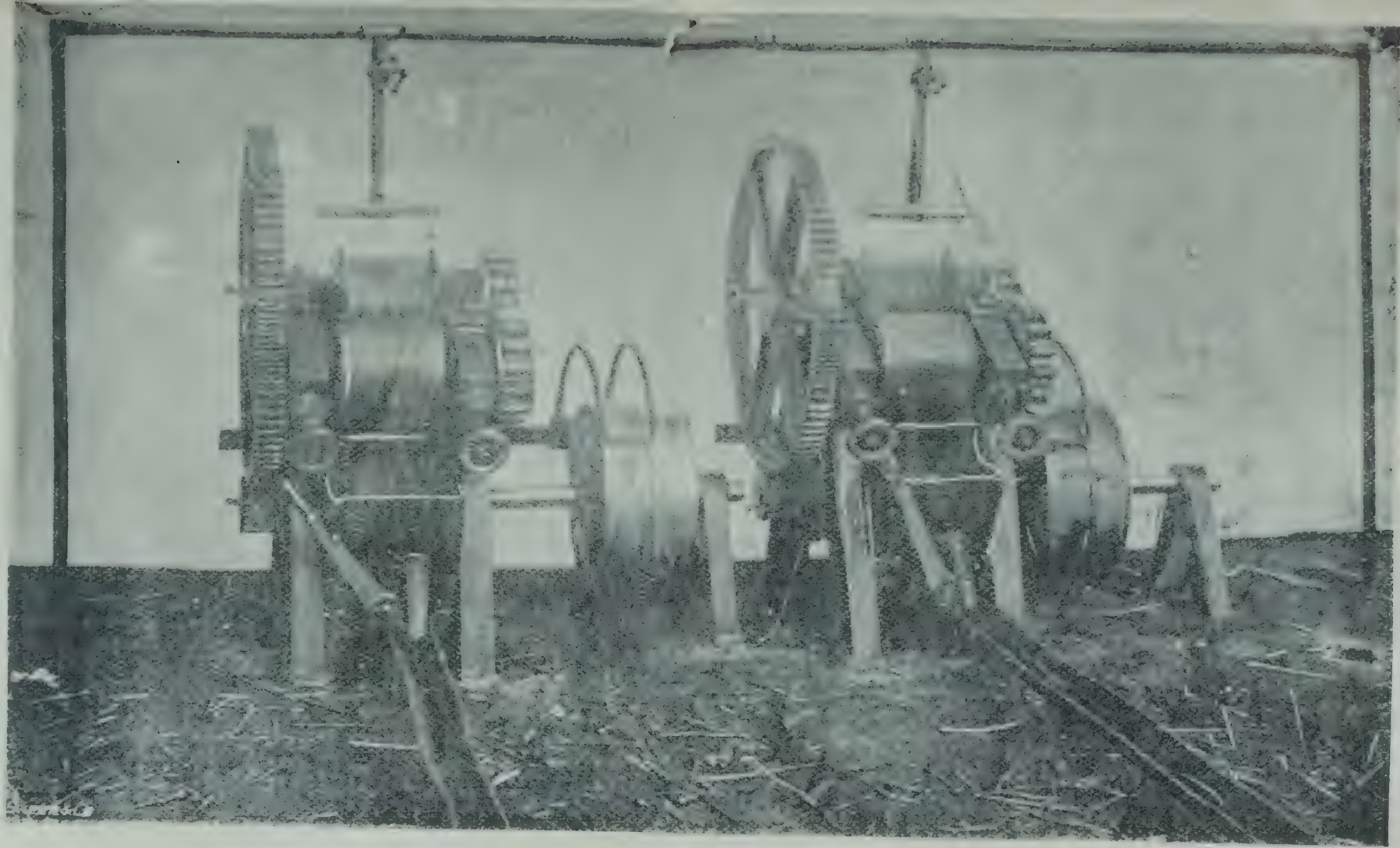
Mr. WRIGHT explained that the lengths of crepe were cut according to the size of the block to be made; an ordinary wet knife was used in the operation, though no doubt it would be well to have a cutting machine to shape and trim the crepe to the exact size needed.

It was pointed that the crepe might be cut to any required length, but how was the width to be regulated ?

Mr. WRIGHT said that after practice and with due care it was easy to produce the crepe so as to make it of a uniform width after leaving the washing machine.

Mr. WRIGHT, on being asked what quantity of acetic acid should be used, said the quantity depended really upon the quality and condition of the latex dealt with.

A PLANTER : Why can't you turn out bark crepe free from tackiness ? You said that the judges had never seen a piece of mouldy crepe ; that did not apply to bark crepe. I want to know why ?



FEDERATED ENGINEERING CO., LTD., WASHING AND ROLLING MACHINES.

Mr. Wright: For this reason. Crepe rubber prepared from bark cannot be kept free from impurities. The crepe form involves the maceration of the bark as well; this means the fine division of all the cellulose, starches, sugars, proteids, &c., in the bark which supply food to the bacteria; when you have the rubber in that state, you cannot eliminate the impurities from it.

A Planter: What do you think really are the advantages of the block?

Mr. Wright: You can see how it saves space. A block like this, a foot square and 6 inches high, weighs 25 lb. As soon as we can get the vacuum dryer, we shall be able to make blocks a foot cube. Apart from the saving in freight, there is the advantage that you will then have a 50 lb. weight of rubber with the least amount of the surface exposed to the air. By reduction in the exposed area you keep away bacteria and reduce the liability to become tacky; you can of course also control the bacteria by excluding the air or by the use of disinfectants. I must tell you, however, that block rubber has still got to be tried with regard to freedom from tackiness. The form is quite new and untried yet, but appears to have everything in its favour.

Mr. Bliss inquired what object there was in gathering latex twelve days and keeping it liquid.

Mr. Wright: The advantage is that you can accumulate the latex of twelve or more days and need not trouble to deal with each day's collection separately. You accumulate the latex until you have a fairly large quantity and then simply coagulate the whole of it at once in from 10 to 20 minutes; you do all your washing, smoking, and blocking, all in two or three hours—that is to say, you prepare the rubber from all the latex collected in one or two weeks in half a day's time. That being so, it is a question for you, practical planters, to deduce the saving in cost and trouble. Then there is the advantage of uniformity. By this method rubber from various trees of different ages collected on different days is left to accumulate together, and is made into one uniform quality. Instead of making rubber from seven-year old trees one day and from ten-year old trees the next day, you prepare one uniform quality of rubber. That may or may not be an advantage; personally I am inclined to regard it as an advantage. Well, gentlemen, I have now shown you the whole range of the rubber machinery here. The only other thing that I can refer to is the curing house, models of which you will find exhibited in various parts of the building.

We may proceed to give the descriptions of the machinery forwarded by some of the exhibitors. and lastly the report of the judges :—

The Federated Engineering Co., Ltd.

Kuala Lumpur, October, 24, 1905.

DEAR SIR,—BELIEVING you to be interested in the economical cultivation and production of india rubber, we take the liberty of laying before you a few of the advantages that may be obtained by the use of our rubber-washing and rubber-rolling machines.

As you are probably aware, we were the first to take up the manufacture of a special machine for the treatment of freshly coagulated latex, and in July, 1905, we exhibited an experimental machine at the Agri-Horticultural Show held in Kuala Lumpur.

The machine was shown doing actual work and producing crepe rubber from latex, kindly provided by many local planters.

The very great success of the machine and high encomiums expressed by Mr. P. Burgess, the Straits Government Analyst, on the excellent results of using such a machine in purifying the rubber induced us to go further into the matter.

We were fortunate in obtaining orders for six machines during the three days the Show was open, and we then re-designed our machine and placed on the market our now well-known 1904 pattern.

Since then experience has taught us many little detailed improvements, and we are now supplying our 1905 pattern washing machine and also a rolling machine of almost identical design, the only difference between the two being that the rolling machine has smooth rollers and is geared to a 1 : 1 ratio instead of the fluted rollers and $1\frac{1}{2}$: 1 ratio of the washer.

The advantages of using our machines for the production of marketable rubber are many and various, and the more important points are briefly enumerated below :—

(1) The action of the rollers on the freshly coagulattd latex is to entirely remove all albumen and other impurities which remain in the rubber (to its consequent detriment) if made into biscuits.

(2) The crepe after being treated on the two machines has a close, fine, even texture and is extremely thin, and can thus be dried, without the aid of an artificial drying house, in about three days, and is considerably easier to pack for shipment than in the biscuit form.

(3) The machines working together will treat at the very least one hundred pounds of dried rubber per hour or singly fifty pounds per hour, and each machine requires from five to eight brake horse power to drive it; only one man is required to feed a machine, and the saving effected over the hand-made biscuit process is obvious.

(4) By the manufacture of crepe rubber the disadvantages of having a large number of coagulating dishes and trays are obviated, as the latex is all poured into one large receptacle and there coagulated in bulk by the addition of acetic acid, tannic acid, or other coagulating agent, after which it is cut into slabs and fed into the washing machine.

The process of making the crepe may be entirely carried out on the washing machine, and many estates are doing this, although a much finer sample is obtained by passing the washed rubber through the rolling machine, and most users are adopting this system, which produces crepe rubber of identical form and appearance with that made by home manufacturers.

Our price for the washing machine is £40 nett cash *ex* works, and that of the rolling machine the same.

We also have in hand a mechanical coagulating device which is still in the experimental stage, but the principle of which has been fully protected by the inventors, and the machine will be very shortly on the market.

We are, &c.,

THE FEDERATED ENGINEERING CO., LTD.

P.S.—Nett weight of washing machine or rolling		lb.
machine, complete	..	1,120
Gross weight, including packing	..	1,360

[Agricultural Bulletin of the Straits and Federated Malay States, October 1905, p. 401.]

Messrs. Brown & Co., Ltd.

Among Messrs. Brown & Co's. exhibits are the Hornsby oil engine, and Macadam's centrifugal strainer, which consists of a perforated metal drum into which a cloth bag is fixed for receiving the latex as it is brought into the factory. The machine is rotated at a very high speed, driving the latex through the close meshes of the cloth and leaving all impurities behind. The cloth bag is then taken out and washed for re-use. The process is practically instantaneous, as the

filtered latex is drawn off by means of a pipe as fast as it is put into the machine, thus effecting a great saving of time as compared with the present method of hand straining, besides which, owing to the filtering medium being of much greater fineness than is possible with a gravity strainer, absolute freedom from all mechanical impurities is secured, and the subsequent operation of washing considerably shortened. This machine gained the gold medal. Mr. Bamber's model of a rubber-curing house on the cold air system, which also gained a gold medal, was made by Messrs. Brown & Co. Mr. Grieve (Messrs. Brown & Co's. Engineering Manager) in conjunction with Mr. Macadam gained a gold medal for their plan of a complete rubber factory. The arrangement of the factory shown is as follows. There is a verandah for the reception of the latex, showing a water service for cleaning the vessels in which it is brought from the field; from here it goes to the centrifugal strainer, and from there to the coagulating machine. After it is coagulated it is taken to the washer, and is then made into biscuits or crepe as may be desired. Accommodation for drying, which is the next process, is shown, and a press for converting the rubber into blocks ready for shipment. Messrs. Brown & Co. also exhibited a large assortment of tapping implements of various patterns manufactured by them. These were not exhibited for competition, the tools having been separately entered by their respective inventors, and among them the Macadam tapping tools may be mentioned as having, in various classes, been awarded two gold medals, one silver medal, and divided a first prize with another.

Messrs. Brown & Co. were unable, owing to the date fixed for the exhibition not permitting it, to exhibit several high class machines manufactured in England for the treatment of latex and coagulated rubber, covering the entire process from the reception of the latex into the factory to the packing of the rubber for shipment, on the system indicated in the plan referred to above. As a side show they displayed specimens of mosaic flooring tiles manufactured at the Hydraulic Brick & Tile Works, Colombo, for which they are managing agents.

Mr. Kelway Bamber's Exhibits.

One exhibit is the drying and rubber storeroom filled with non-actinic glass windows to keep out direct sunlight. It shows accommodation for a motor to drive a refrigerator; brine tanks of the usual type, connected with a range of circulating cold water tubes in an air duct. The moisture coming into contact with the tubes will freeze. The duct is in connection

with the drying room, and before the air can pass from it to this it must go over heating tubes containing hot air or hot water in order to bring the temperature of the room up to 100 or 110° F. There is a fan above in the duct, which extends across the ceiling. When the fan is set going it draws the hot, moist air from the top of the factory and drives it over the brine pipes. The moisture in the air accumulates on these pipes in the form of snow, which gradually melts and runs out. Then the dried air goes over the heating coils to be re-heated and circulates. Thus a constant supply of dry air is kept in the drying room at any convenient temperature from about 40° F. to 110° F. The store may be used for any drying purpose.

The other machine is for straining latex, the principle being to collect solid impurities on the wall of the drum. Messrs. Brown and Co.'s machine is somewhat similar, but with a perforated drum to remove impurities by filtration through cloth.

Methods of Manufacture and Preparation of Block Rubber.

By Francis Pears, Lanadron Estate, Johore.

Seeing the attention this has attracted both at the Singapore Agri-Horticultural Show and at the Ceylon Rubber Exhibition, it would not seem out of place to fully explain the points in its favour and the details of its inception, as claimed by the makers. The prize "block" was manufactured by the Lanadron estate of Muar, and the awards made by the Judges of both Exhibitions are fully confirmed by the buyers at home who value this method of preparation at 3*d.* per lb. higher than the best sheet or crepe.

This will, of course, have the effect of inducing many planters to take up this method of preparation, and it is to be hoped that in doing so they will recognize that it requires good machinery and that good "block" is not to be manufactured by immersing sheet or biscuits in hot water and hydraulic pressing. This would only imitate it in appearance and not in quality.

The manufacture of "block" by the Lanadron estate was conceived, in the first instance, as a means of turning out a rubber of standard uniformity in a practical manner, and one which would commend itself to those manufacturing rubber on a large scale; also to be a handy form for shipping and for storage at home. That this has been accomplished must be apparent to everybody. Added to this the improvement in the quality undoubtedly establishes this as the best means of manufacturing raw rubber hitherto employed. In considering any new methods referring to the treatment of raw rubber,

there are certain axioms to be considered, the most important of which are the following :—

1. Uniformity.
2. The eradication, as far as possible, of organic, and the complete removal of inorganic, impurities in the latex.
3. Acceleration during manufacture to reduce to a minimum exposure to the air.
4. Small surface exposed after manufacture.

Rubber manufactured with a view to these principles, besides having the characteristics of a good commercial rubber, will give a system which would appeal to anyone who takes an intelligent interest in this industry and is desirous of establishing a factory organization on up-to-date principles, and where manual labour will be reduced to a minimum.

Coagulating Latex in Bulk.

1. Respecting uniformity, the only way to accomplish this is to mix the latex and coagulate in bulk. It has been suggested that the latex from trees of different ages should be kept separate, but this proposition is not one that could easily be carried out in practice. It would be much better to start with the uniform standard ; and if old trees really do give a superior latex, the product of the estate must gradually improve with age. It has not yet been proved conclusively that the older the tree the better the rubber, although there are many indications pointing to this conclusion.

Washing the Freshly Coagulated Latex.

2. The eradication, as far as possible, of organic, and the complete removal of inorganic, impurities in the latex. The only way to effect this, as everybody who is interested knows, is to wash the freshly coagulated latex on an ordinary washing machine, such as manufacturers use at home. In fact it is the only practicable method of reducing coagulated latex in bulk to uniformity of size, at the same time thoroughly washing every particle of rubber and removing all mechanical, besides a good deal of the organic, impurities. Tackiness, of which we have heard a good deal lately, and also mildew are a species of micro-organisms, and, although of frequent occurrence in biscuits, seldom if ever occur in properly washed crepe. This is strong testimony to the fact that washing freshly coagulated latex removes some of the organic impurities which are detrimental to the keeping properties of raw rubber. Whether

in addition to this it may be advisable to impregnate the latex with some antiseptic, such as smoke (creosote), formaldehyde, &c., is a matter for further experiment.

Vacuum Drying.

3. Acceleration during manufacture to reduce to a minimum exposure to the air. Despatch during manufacture can only be accomplished by accelerating the drying process, as hitherto this has occupied periods varying from a few days to as many weeks, with exposure all the time to the action of the air. Vacuum drying is the only practicable solution to this, as it combines two very essential points, viz., rapidity, without any exposure to the air. By this means it is possible to dry the rubber in two or three hours. Exception has been taken to the use of vacuum dryers as making rubber sticky, but this is only a matter of temperature, which can be regulated mechanically. It is certainly rather a delicate operation and requires a man in charge who thoroughly understands the principles of the machine.

4. Small surface exposure after manufacture. After removal of the crepe from the vacuum drier it is in a pliable condition in consequence of not being subjected to the hardening influence of air drying (oxidation). In this state it is easily pressed into any convenient shaped "block," and the whole forms a perfectly homogeneous mass, hermetically sealed, with a minimum surface exposed to the air and light.

The following remarks of the delegates of the United Planters' Association of the Federated Malay States may also be quoted here : —

Glancing through the above list one is at once struck with the small number of awards made. Nowhere indeed is the fact so strongly brought home as in this section, that the whole industry is still in its first infancy. Everywhere most promising beginnings and ideas are met with, but it is quite evident (and nobody is readier to admit this than the manufacturers themselves) that all the apparatus and machinery exhibited are indeed far removed from finality. This does not prevent a great many of the exhibits from being extremely useful and very superior to previous methods, and no doubt one of the most important results of the Exhibition has been to stimulate competition, and collate the results achieved, in this section, which is becoming more and more rapidly important to planters as the tappable area of the different estates increases......

For assisting the flow of latex ordinary latex-collecting cups with a hole in the bottom, through which a wick passes, entered by Brown & Davidson, Limited, were awarded

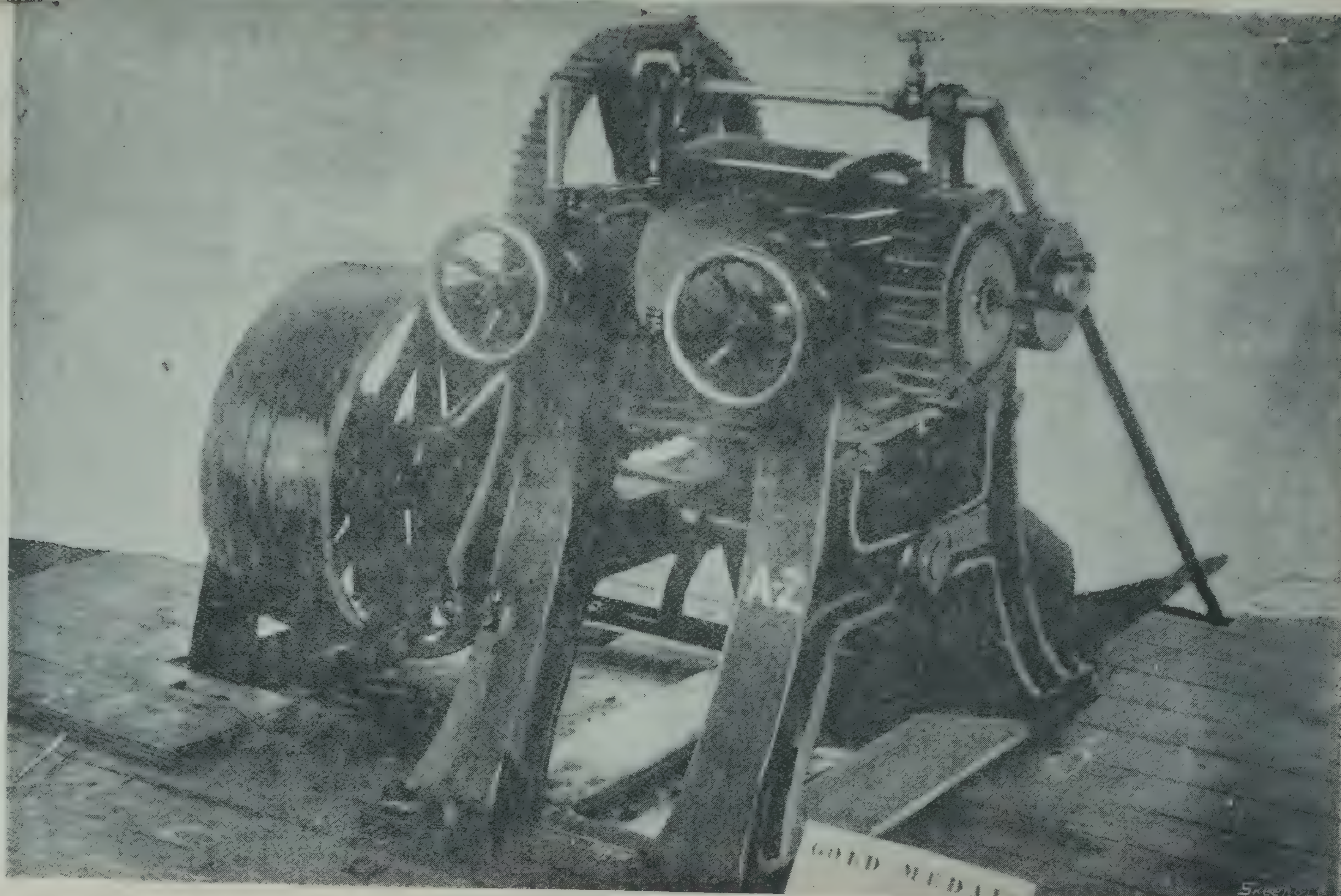
a silver medal, the Judges evidently and quite rightly considering that this method was not exactly the last word that could be said on the subject. The cups are filled with water and formalin, and it is claimed that there remains almost no scrap to be collected. Another entry was a squeeze oil can by Mr. J. A. Bird of Duckwari estate, quite an ingenious method, and one which should answer as well as any.

For centralizing the latex from different trees several models were shown, but none were deemed worthy of an award, and certainly none looked very practical.

For storing latex, Messrs. Brown & Davidson, Limited. exhibited an apparatus, which they described to me as a tank containing a propeller and a circular drip tin, which latter admits 10 to 20 drops of dilute formalin per hour. The propeller is occasionally turned, and the formalin and latex thereby thoroughly mixed. Apparently this machine fulfils all its claims, for it was shown that latex that had been kept for ten days in this tank had lost none of its essential properties. The inventor, Mr. G. S. Brown, also told me that by reversing the propeller movement a coagulator is obtained, the active principle being that the caoutchouc globules are thrown upwards. The whole idea seems very ingenious, but no doubt requires further working out, as the apparatus was really never shown in working nor the inside mechanism opened up for the inspection of the public.

In the next class, " Best method of determining the amount of acid required for coagulating latex," no awards were given, no doubt because the well-known litmus test is still the simplest and best. In this connection it is as well to mention that all lecturers were unanimous in pronouncing a surplus of acetic acid as very seriously deteriorating the strength of rubber and strongly recommending all planters never to omit using some litmus paper when adding acetic acid to the latex. Fresh latex is slightly alkaline, and only just sufficient acetic acid should be used to turn the latex acid. As soon therefore as the litmus begins to turn pale pink quite enough acid has been added to the latex, and any further quantity can but do harm, as it is questionable whether even immediate and repeated washing in the machine will completely remove all traces of acetic acid.

For the best method of coagulating latex the Michie-Golledge coagulator was awarded the gold medal. All users speak in the highest terms of this machine, which frequently during the Exhibition demonstrated its capability of coagulating 8 to 10 gallons of latex in a few minutes. A couple of coolies represent the sum total of power required, and the principle of using the centripetal force of rotating latex is very



MESSRS. BROWN & DAVIDSON'S RUBBER-WASHING MACHINE.

clever. The presence of acid however is necessary, and this method of coagulating of course does not do for biscuits ; but for dealing quickly and effectively with large quantities of latex some such machine as this Michie-Golledge will without a doubt have to be employed on all estates where increasing areas come into bearing.

Mr. J. A. Bird's method of coagulating latex, for which he received a silver medal, consists of the following two recipes :—

1. One dram cream of tartar, dissolved in 1 oz. of cold water, added to a pan full of latex of about 48 oz.
2. Half dram cream of tartar dissolved in 4 oz. of fresh rubber whey added to a pan full of latex of about 48 oz.

The idea is quite an original one, and the results, to judge from the Duckwari biscuits, are excellent.

In the next class (" Best apparatus for preventing putrefaction of rubber ") Messrs. Brown & Davidson's latex-smoking machine was awarded the gold medal. This machine consists of a series of circular baffle plates, arranged one below the other, so that the latex, which is poured in at the top, has to drip from one to the other, until it reaches the bottom, where it is collected in a bucket. The whole of this is enclosed in an iron cylinder, which can be opened and shut at will, Outside the apparatus a fire box is provided, in which wood soaked in creosote is made to smoulder, the smoke of which is taken into the cylinder, where it ascends and meets the latex dripping over the baffle plates, the result being the impregnation of every particle of latex with this creosoted smoke.

Whilst in this case the smoked latex has to be coagulated afterwards in the ordinary manner, Mr. C. O. Macadam was kind enough to show me an apparatus of his, which smokes the latex and coagulates it at the same time. This apparatus is being used on Culloden estate, but was not exhibited. It consists of a series of metal planes, slightly inclined and placed in zig-zag fashion one below the other. The latex is poured in at the top and has to flow over all these planes, being caught at the bottom in a pail. The whole is enclosed in a box with an aperture to admit the smoke, which thus completely fills the interior and thoroughly impregnates the latex. The latex, being poured in again and again, very soon begins to form on the plates films of coagulated rubber which fairly rapidly increase in thickness, and eventually form very excellent looking smoke-cured sheets, which only require drying to be ready for the market.

In the next two classes (" Best apparatus for recovering rubber from bark shavings, twigs, leaves, and prunings of

rubber plants" and "Best rubber-washing machine") the now very well known macerators and crepe machines of several makers were shown. In each class Messrs. Brown & Davidson, Limited, carried off the gold medal, and Messrs. the Federated Engineering Co., Ltd., the silver medal. The difference in the two makes is in detail only, the former being more substantial looking and of better finish, but, of course, also more costly. No English-made machine was exhibited, which is to be much regretted, since all users of these latter machines are loud in their praise of the durability and efficiency of the home-made article.

The gold medal for the best curing apparatus or model of curing-house was awarded to Mr. M. Kelway Bamber. The principle employed by him is to dry the air by employing a refrigerator with the usual brine tank. There is also a range of circulating cold water tubes. These tubes are in an air duct; they are very cold and water coming in contact with them will freeze. This duct is in connection with the drying room, but before the air can pass through the duct to the drying room it must pass over heating pipes of hot air or hot water to bring the temperature of the room to 100 or 110 degrees. Authorities differ as to the best temperature, but the planter can get any temperature he likes. There is a fan at the top in the duct which, when you set it in motion, takes the hot moist air from the top of the factory and throws it on to the brine pipes, where the moisture from the air is accumulated in the form of snow. As they get heated the snow melts and runs out in a channel provided. The air goes back over the heating coils, is re-heated and circulates, and a continuous supply of hot dry air is thus provided. The plan seems a very promising one, and I understand is to be tried on several estates in Ceylon.

Messrs Brown & Davidson, Limited, showed a screw press with which they succeeded to make several quite neat looking blocks of rubber. The Judges considered this of sufficient merit to award them a special gold medal (for "best apparatus for blocking rubber").

The next class ("Best apparatus for removing mechanical impurities in latex") produced two interesting entries, one made by Mr. C. O. Macadam (who received the gold medal), and one by Mr. M. Kelway Bamber (who was awarded the silver medal). Both machines are rotary, but whilst the former is not capable of separating fine sand, the latter is unable to deal with anything lighter than latex (*e.g.*, leaves, twigs, &c.). The two therefore really supplement each other, and latex passed first through the Macadam strainer and then through the Bamber separator can be depended upon to be

absolutely pure from all mechanical impurities. I was present at the testing of both machines by the Judges, and can testify that they were pretty severe. Lumps of earth, fine sand, handsfull of dust were added, without however leaving any traces behind in the purified latex. This method will deserve closer attention in the future, when, as we all hope, the planter will be able to turn out rubber of so pure and uniform a character as to enable the manufacturer to straightway use it, without further subjecting it to any washing, &c., processes.

The only other award made was in the class "Best and most promising method of vulcanizing, hardening, or colouring rubber." This was a special gold medal awarded to Mr. M. Kelway Bamber for his exhibit as an object of special interest.

No exhibit in the following classes was deemed worthy of an award: "Best method of protecting the tree during tapping;" "Best method of expelling water from freshly coagulated rubber;" "Best method of destroying stumps;" "Best method of packing rubber for export;" "Best method of testing resiliency and other qualities of prepared rubber;" which will show that there is still plenty of scope for the inventor.

As regards the last-named class, Mr. J. B. Carruthers had entered his machine. This arrived unfortunately in a broken condition, and was never shown working. In any case it would seem that his machine cannot be considered of practical value, until we have a microtome or similar instrument, which will cut rubber into strips of mathematically identical dimensions.

In place of a General Report by the Judges,* we end with the report by Mr. G. H. M. Hyde, H.I.M.E., A.M.I.C.E., Acting Factory Engineer, Government Factory, Colombo, which calls attention to mechanical points, defects, &c., and will be very useful to designers of such machinery in future.

Report on Machinery exhibited at the Ceylon Rubber Exhibition in 1905.

The machinery section was housed in a detached set of buildings consisting of two open-sided sheds placed parallel to each other. The motive power for the rubber machinery was supplied by Messrs. Brown & Davidson, Ltd., with a 12 H. P. Nonpareil oil engine, which drives a line of shafting 60 feet in

* The Judges were Messrs. J. B. Carruthers, M. Kelway Bamber (except classes in which he was exhibiting), C. Christy, G. H. M. Hyde, and J. C. Willis.

length erected on suitable bearings and cast iron chairs in a line midway between the two sheds and parallel to them. the various machines being connected up with belts, and by Messrs. Brown & Co., Ltd., with a Hornsby-Akroyd engine of similar power. An 8-H. P. portable steam engine and boiler was also worked in order to drive a dynamo and to supply steam to Mr. Bamber's camphor installation, &c.

The Western shed contained the following machines :—

8-H.P. Portable steam engine, boiler and dynamo (Messrs. Robey & Co.).

12-H.P. Nonpareil oil engine exhibited by Messrs. Brown & Davidson, Ltd.

One rubber-macerating machine, by Messrs. Brown & Davidson, Ltd.

Two rubber-washing machines, by Messrs. Brown & Davidson, Ltd.

One model washing machine, Messrs. Brown & Davidson, Ltd.

One smoke-drying apparatus, Messrs. Brown & Davidson, Ltd.

Several types of rollers for Messrs. Brown & Davidson Co.'s machines.

One Michie-Golledge coagulating machine, with a horizontal mangle or roller, by Messrs Walker, Sons & Co., Ltd.

In the Eastern shed the following machines were exhibited :—

Two rubber machines by the Federated Engineering Co., Limited.

Latex filter by C. O. Macadam, Esq.

Latex filter by Mr. Kelway Bamber.

Camphor installation by Mr. M. Kelway Bamber.

Cotton ginning machine by Mr. Whitehead.

One model of a curing-house by Messrs. Brown & Davidson, Ltd.

Apparatus for removing Mechanical Impurities in Rubber Latex.

Two machines were exhibited in this class, one by Mr. C. O. Macadam, to whom a gold medal was awarded. and one by Mr. Kelway Bamber, who received a silver medal.

Both machines are rotary, and with the exception of the central basket or drum, are of the same design, but with the one type of drum only the larger and lighter impurities can be removed, whilst with the other type only those particles of sand and grit, &c., are eliminated which are of a greater specific gravity than that of the latex.

Mr. Macadam's exhibit, *i.e.*, the one which removes the larger and lighter impurities from the latex is a 12-inch self-balanced centrifugal machine with a rope drive; it is composed of a cast iron pedestal surmounted by a cast iron casing with a dished bottom and outlet lip, the top being fitted with a cover having a funnel in the centre for the purpose of feeding the machine. Inside this casing a basket or perforated drum revolves, being actuated by a vertical shaft whose bearings are in the neck and foot of the pedestal. The basket is not compelled to revolve about a fixed centre as in other machines, but is permitted to find its proper centre of rotation by the use of elastic bearings, thus reducing the power required to drive the machine to a minimum, as also the amount of vibration transmitted to the casing of the machine. The vertical shaft is driven at the rate of three thousand revolutions per minute by means of a rope drive from a small countershaft carried by swing bush bearings mounted on a cast iron frame. The shaft is also fitted with fast and loose pulleys for belt driving. The lubrication of the swing bush bearings of the countershaft, as well as in the bearings in the machine proper, are most efficient, the former being self-oiling and the latter being fed from an oil cup and tube outside of the casing and pedestal. The machine is fitted with a suitable foot brake to enable the operator to stop the process at any moment. The machine was thoroughly tested by passing latex which had been freely and well mixed with sand, lumps of earth, chips, twigs, bark, &c., through the funnel in the top lid of the outer casing and into the centre of the revolving basket or perforated drum. Inside the latter is placed a linen or cloth bag, and it is through this that the latex is rapidly strained leaving the lighter and large impurities behind it. The strained latex then passes into the outer casing and finally issues from the pipe at the side into a receptacle below. By this means large quantities of latex can be strained in a very short time.

The machine takes about 1 H. P. to drive, and its output is 50 gallons per hour.

The machine shown by Mr. Kelway Bamber is much the same as that exhibited by Mr. Macadam, except that no cloth bag is used and that the bottom and the periphery of the drum are solid, and the top also is partly closed.

The latex is poured into a funnel in the lid in the same manner as that described in the other machine, except that it has to be very carefully and slowly fed into the centre of the revolving drum. The heavier particles of the impurities in the latex are thrown centrifugally against the periphery and are there collected and retained, being helped somewhat by

means of short partitions, whilst the pure latex rises over the top of the drum into the outer casings and then finally issues from a pipe into a receptacle below. The output of the machine is roughly estimated at 20 gallons per hour.

The workmanship and finish of both machines are very good indeed, everything having been most carefully designed.

Best Method of Coagulating Latex whether by Acid, Decay, Smoking, or Otherwise.

A gold medal was awarded to Messrs. Walker, Sons & Co., Ltd., for their Michie-Golledge coagulating machine.

This machine consists of a cast iron frame or pedestal which carries a vertical shaft whose bearings are placed in the central bar and base. The shaft is fitted with a belt pulley, and has fixed to its upper end a vertical drum of about 10 gallons' capacity. The bottom of this drum is fitted with an outlet plug, but the top is left open. Eight small flat battens or ribs are fastened axially and equi-distantly round the inside circumference. Four fixed battens or blades are hung vertically inside the drum and just clear of the axial battens and the bottom of the drum. They are suspended from a circular plate supported at the top of the frame.

Ten or twelve gallons of latex mixed with water and acid are poured into the drum, and as soon as the machine is put into motion the latex by one set of battens is acted on centrifugally, and afterwards a centripetal action is induced by the fixed set of blades. During the first two or three minutes the machine should be driven at a speed of about 180 revolutions per minute; at the end of this time the sound from the drum will have become deadened and the latex in the centre will have taken a spongy appearance. The speed should then be reduced to 120 revolutions and a little later to 100 revolutions. The coagulated rubber begins to form into a spongy mass between the blades and in the centre of the drum in four minutes from the time that the machine starts working, and in five minutes the process is complete.

The horse power required to drive the machine is nominal, the machine exhibited being fitted with hand gear and easily driven by two coolies.

The workmanship and finish of this machine was excellent.

Apparatus for Preventing the Putrefaction of Rubber.

The only apparatus exhibited for this purpose was one manufactured by Messrs. Brown & Davidson, Ltd., to whom was awarded a gold medal.

The apparatus consists of a fireplace in which wood soaked in creosote is allowed to smoulder; from thence the smoke passes along a flue or pipe connected to the bottom of a sheet iron annular column about 6 feet in height and from 3 to 4 feet in diameter. The inner column is a closed sheet iron cylinder finished off at the head in a conical form and surmounted with a funnel ; on the other hand, the outer casing is made in two halves hinged together like doors. The whole height of the annular column, that is, the space between the two cylinders, is baffled by means of a series of circumferential plates or rings inclined downwards. These plates are rivetted to each of the cylinders alternately, thus forming a complete series of baffle plates. The head of the annular space is fitted with sliding doors which are easily adjusted in order to allow for the egress of smoke or admission of air.

The working of the machine is thus: the fresh latex is poured through the sieve into the funnel at the top of the inner column, the flow being distributed over the whole of the circumference of the inner cylinder by means of small channel ways; from thence it slowly flows over or drips from each baffle plate in turn, *i.e.*, down through the whole height of the annular column, thus exposing a large surface for impregnation with the creosote-laden smoke with which the whole annular space is filled from the adjacent slow combustion fireplace. The smoked latex is collected in the dished bottom of the annular space and finally issues from a pipe into a receptacle below, to be put through the machine again should it require further treatment.

The machine, however, will require considerable improvements in detail to make it of general utility.

Best Apparatus or Method for Recovering Rubber from Bark Shavings and the Best Macerating Machine for Obtaining Rubber from Twigs, Leaves, or Prunings of Rubber Plants (Two Classes amalgamated).

Two machines were exhibited for this class of work, one by Messrs. Brown & Davidson, Ltd., which obtained the gold medal, and another by the Federated Engineering Co., Ltd.

The machine exhibited by Messrs. Brown & Davidson, Ltd., is of a strong type. It has two revolving rollers $9\frac{1}{2}$ in. diameter and 18 in. long, one being fixed, *i.e.*, the bearings are fixed, whilst the other roller has adjustable bearings. The rollers are geared to each other with cast iron spur-wheels in the ratio of 2 to 1, and their axles rotate and are carried in square cast iron

gudgeon blocks of an adjustable type, provision being made for them to slide in open parallel slides left in the two side frames forming the framework of the machine.

The gudgeon blocks of the roller nearest to the operator are made adjustable by means of two springs and two screws fitted with hand wheels, the former keeping the rollers apart and considerably lessening any jarring that might take place, and the latter enabling the operator to reduce or increase the distance between the rollers by the working of each hand wheel in turn. This arrangement however is somewhat slow and awkward, and it would have been much better to have made the adjustment by gearing the two screws together and working them with one hand wheel only. The main shaft of the machine is fitted with a fast and loose pulley for belt driving and is supported by three bearings, one in each side frame, the third bearing being carried by a chair pedestal. A pinion on the main shaft drives a spurwheel attached to the axle of the roller which is in the fixed bearings at the rate of 3 to 1. The rollers are really what are called compound rollers, *i.e.*, the right-hand halves are cut with spiral grooves along their length in a right and left direction, which as the rollers travel at different speeds of 1 to 2 macerate and reduce the bulky material to a pulpy mass. The left-hand portions of the rollers travelling at the same ratio do not tear and macerate to the same extent, as they are only cut with small horizontal flutings, but only further wash and partially bind the rubber recovered from the right-hand rollers into free or loose crepe. Immediately above the rollers are two wood hoppers (right and left-hand) into which the materials for the rol ers are fed. A perforated water pipe supplies a spray of water to wash the mass of material as it passes through the rollers. A water trough below the rollers of the machine enables all the pieces to be recovered by the operator, to be passed again as often as may be required through the roller.

The machine is belt-driven, and will take about 6 H. P. to drive when macerating materials.

The machine exhibited by the Federated Engineering Co., Ltd., to whom the silver medal was awarded, is small and very compact. The two cast iron frames or side cheeks of the machine carry two small turned rollers 9 in. diameter and 9 in. long, their centres being placed obliquely. The bearings of the upper roller are fixed, whilst those of the lower one are adjustable by means of two screws fitted with hand-wheels and winged back nuts. An arrangement whereby the roller could be adjusted by turning one hand wheel would be preferable. No hopper is fitted, only two side guides, but a water service is provided giving a spray over the materials

which are to be crushed. The machine is small and light, therefore not very powerful for macerating purposes; this type of roller does not give very efficient results for this class of work. Five to eight H. P. are required to drive the machinery, and only one man is required to feed it.

In regard to all the machines in this class and in that of the "washing" class, it is to be remarked that their constructin is very deficient in providing for the safety of the operator; for instance, none of them is fitted with a suitable clutch actuated by either a handle or knee stop within the reach of the operator whereby he could stop the machine in the event of his getting his fingers or clothing between the rollers, accidents which under the present method of feeding the rollers might be frequent. Then again there is, with one exception, practically a total absence of wheel guards over all the spur gearing—a serious omission. All the roller bearings too have not received sufficient attention, for, in the first place, with one exception, none are gun-metal bushed, being iron in iron, and secondly the question of their lubrication has not been properly considered, for there is nothing to prevent the oil from trickling down from the bearings and coming in contact with the materials being operated on.

The workmanship generally was fairly good of its kind, but there was a lack of finish in all these machines.

Best Rubber-washing Machine (Impurities after Coagulation).

There were seven machines exhibited in this class—three large machines and one model by Messrs. Brown & Davidson, Ltd., two by the Federated Engineering Company, Ltd., and one by Messrs. Walker, Sons & Company, Ltd.

Messrs. Brown & Davidson, Ltd., obtained the 1st prize, a gold medal, for their machine, which is of a similar type to the combined macerator and washer for which a gold medal was awarded in that class. This smaller machine however is made from practically the same patterns with the exception that the rollers are 10 inches long instead of 18 inches, the diameter being the same. Any type of surface for the rollers can be used, *i.e.*, either fluted or smooth, both being supplied. The rollers are geared to run as two revolutions of the one to one revolution of the other, so that the rubber sheet is thus stretched sufficiently to clean it from all albumenoid and mechanical impurities; at the same time it rolls it out into either a thin sheet or crepe ready for drying, *i.e.*, after it has been well washed by either hot or cold water playing on it during the process of the rolling and cleaning.

The other machines were of similar design, only smaller. The model however was fitted with a rubber travelling belt, and rollers 14 in. long by $5\frac{1}{2}$ in. diameter; the adjustment of the rollers was good.

The second prize, a silver medal, was awarded to the Federated Engineering Company, Limited, for their two machines which are described in the former class as the same machines can do this work also.

The output from one machine is one hundred pounds of dried rubber per hour; it requires from 5 to 8 H. P. to drive it.

Messrs. Walker, Sons & Company, Ltd., also exhibited a small washer, and roller, but this had not been arranged to work for the Judges: it is however very similar in design to those made by the Federated Engineering Company, Ltd., except that the roller adjustment was very badly designed. The workmanship and finish however is good.

The same remarks in respect of lack of provision for the safeguarding of the operator, lubrication, and construction in regard to bearings and adjustments, as were made about the machines in the Macerating Class equally apply to these machines.

Best Model of Curing-house or Curing Apparatus.

There were two models exhibited showing the methods of curing or drying rubber in either biscuit, crepe, or other forms; the one by Mr. Kelway Bamber was awarded a gold medal, and another model was shown by Messrs. Brown & Davidson, Ltd.

The model exhibited by Mr. Kelway Bamber is a longitudinal section of a curing or drying room with an engine-house annexure. The principle employed by him is to first dry the air by means of a refrigerator with the usual brine tank and concomitant machinery, these latter being placed in the engine room. The circulating range of brine tubes of the refrigerating apparatus are placed in the air duct supplying air to the adjoining curing room. The hot and moisture-laden air is drawn from the top of the curing room by means of a fan and driven down through the air duct, where it encounters the cold refrigerator pipes. The moisture is then condensed on the pipes in the form of snow, and when the warmer air touches the pipes the snow melts and drips off them, finally escaping in a channel provided for it. From the bottom of the air duct, and after refrigeration, the dry air passes through a heater which is made of a series of cast iron pipes where it is raised to a temperature of 100 or 110 degrees, or

whatever temperature is desired, before it passes into the curing room, in which the rubber is placed for the purpose of drying. All apertures in the drying room are closed, so that the air is constantly in circulation in a closed circuit, *i.e.*, in being pumped through the curing room air duct with refrigerating and heating pipes, &c., and then into the curing room again. The rubber to be dried is thus exposed to a continuous current of dry as well as hot air, which is not obtainable by only heating the ordinary atmosphere. The room is fitted with non-actinic glass, so that there is no risk of tackiness arising from exposure to sun. The continuous freezing and heating of the air sterilises it.

The other model exhibited is one by Messrs. Brown & Davidson, Ltd. It is a small model of a curing room in which the rubber is subjected to a current of air after this has passed over layers of calcium chloride.

The room is a closed one and fitted with a framework to carry biscuits, crepe, or worm rubber. The air on its admission into the curing room enters a small chamber or iron box at the end of the room. This box contains tiers or trays upon which is placed calcium chloride and it is over these trays that the air passes, the calcium chloride absorbing the moisture. An exhaust-fan fixed in the wall at the opposite end of the curing room draws the dried air through the chamber and afterwards through the framework which carries the rubber to be dried, and finally ejects the moisture-laden air from the building. The difficulty in this system is the cost of dehydrating the calcium chloride; in fact it is so costly as to make the process prohibitive.

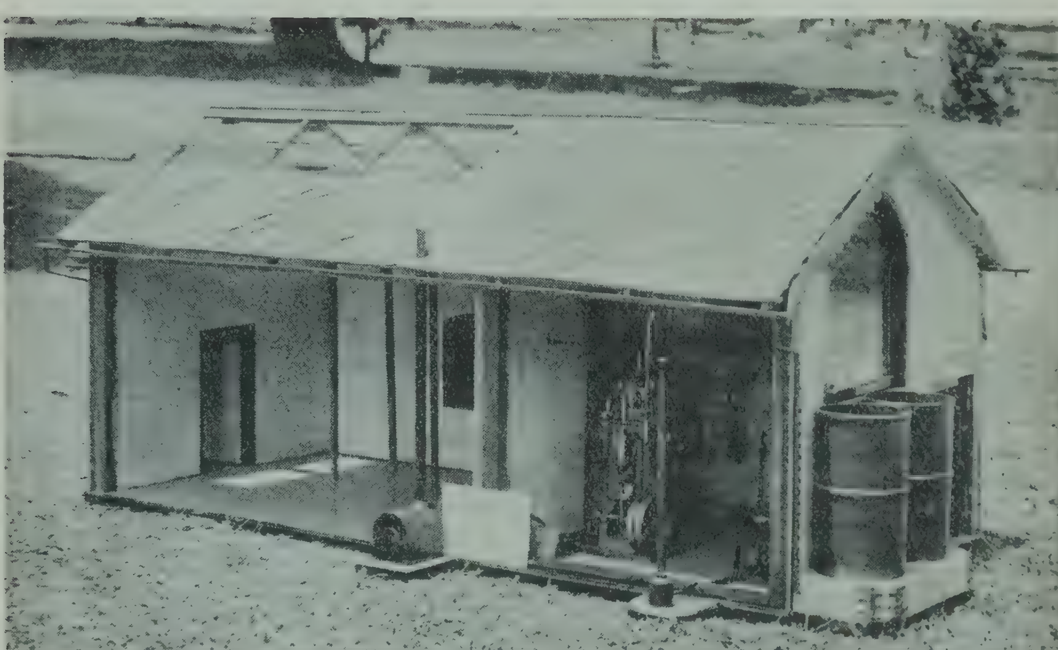
Hand Press for Block-Rubber.

Owing to the rubber experts' opinion that the future method of exporting rubber would be in the "block" form, it was thought desirable by the Judges and Committee that a special prize should be given to Messrs. Brown & Davidson, Ltd., for their "hand-press."

A wooden frame over a table holds the 3-in. diameter steel screw of the press. The base is of cast iron. By means of an adjustable double lever mechanism, the press may be worked in any position and from one side only, if required, so that it may be placed against a wall or in a corner without any inconvenience in working. Each backward and forward movement of the lever gives pressure and economizes half the time in working. The application of the pressure is accomplished

by two reciprocating traverses, and by a special contrivance it is possible to work either with less pressure and highest rapidity or with moderate rapidity and the highest degree of pressure. The rubber is placed in a receptacle below the screw and plate and is squeezed into whatever rectangular form is desired.

G. H. M. Hyde.



MODEL OF A CURING-HOUSE BY MR. KELWAY BAMBER.

Won Cup of the value of Rs. 150 offered by the Ceylon Planters' Association for the best designed Curing-House to deal with Biscuit and Crepe Rubber

CHAPTER VII.

SHIPMENT AND MARKETING OF RUBBER.

WE may now go on to the very important subject of the shipment of rubber to London, and its treatment when it arrives there. Lectures upon these subjects were given by the three judges of the raw rubber, who being representatives of some of the largest rubber brokers in London, may be assumed to be high authorities upon these questions. There seems to be a general feeling in favour of block as the best form in which to put up the raw rubber, and tea boxes, or something of the sort, in which to pack it.

Shipment of Rubber to London.

By Mr. C. Devitt.

On Saturday morning a lecture was delivered on "Shipment of Rubber to London" by Mr. C. Devitt, one of the rubber judges. Dr. Willis presided.

Mr. Devitt said: One of the most important points in the packing of plantation rubber is, as you all know, to get it absolutely dry and quite free from surface moisture before shipping, as any dampness, even if it is only on a few biscuits or sheets, is likely to ruin the whole case full. We very often find where moisture has been left, the rubber had turned white and decomposition had started making it unsightly, weak, and evil-smelling. Another thing of importance is not to put biscuits showing the slightest trace of tackiness into the same case with fine. We also very often find good scrap spoilt by tacky pieces and rejected from the fine being put in with it. Buyers do not like qualities mixed at all, and frequently parcels are spoilt by the presence of a few pieces of inferior quality. Even if there is only one piece, it has to be

shown in the sample. Crepe is the worst offender. Samples of a shipment come up from the wharf, fine pale rubber, with one or two inferior dark pieces. When the buyers see these they mark it down in their catalogues as fine pale crepe mixed with inferior dark and value accordingly, not knowing what proportion it is in and to obtain which involves great expense and trouble. Some planters grade their rubber and mark it accordingly, such as No. 1, 2, and 3. There may be only the slightest difference in the quality and appearance of say No. 1 and No. 2 crepe, but a buyer having an order for No. 1 at 5*s*. 7*d*. would, perhaps, be willing to pay just a shade under for No. 2, but seeing it marked as No. 2 he would be afraid to buy it as No. 1. The size of the case is quite unimportant now that the draft is uniform ; $1\frac{1}{2}$ cwt. seems to be a popular weight, but it really does not matter so long as you don't make them too heavy, as it causes extra labour in handling them. To have good strong cases is essential. The rubber is liable to contract in transit between the estate and London and becomes a loose mass bumping about inside, and an extra rough piece of handling will knock the sides out.

Paper must on no account be used in between the pieces. It does not matter whether biscuits, sheet, or crepe, in nine cases out of ten, it will stick and cause great expense to have it removed. It is impossible to say in what form the rubber is to be sent in the future, but at present the block seems to be most popular among everybody; 2*d*. per lb. is a big premium; we very seldom see a difference of more than $\frac{1}{2}d$. per lb. between fine and extra fine. As a rule when the price is made the rest go at the same, unless there is anything wrong with a lot and then a $\frac{1}{2}d$. or 1*d*. is knocked off, or there may be a small order for a very fine and then you may get a $\frac{1}{2}d$. more. There is no objection to biscuits or sheet in London, but it is for planters to decide whether they can make them and dry them in their thousands. With regard to scrap the old hand-made form is still the most popular for the reason that buyers can see exactly what is in it, while the majority of crepe scrap is dark and appears to have foreign matter in it; but I understand that the former gives far more trouble and takes a great deal longer to prepare than the latter ; therefore it will have to come as crepe and buyers will get to know certain marks and will be sure of what they are getting and always stick to them. At present crepe is valued almost entirely on colour, and I heard of a case from a planter where he sent home some scrap crepe of very good colour and realized within a shade of fine, but he thought he would improve on it by making it thicker, which, of course, made it appear darker. For this he only got the price of scrap.

It is very hard to find out if a new form is liked on the market. A planter may invent some new method and ship a parcel over. Buyers eye it suspiciously and will not give its real value; the planter hears the result of the sale and stops making any more and goes back to the old. Things must find their level soon, and we hope before long to get manufacturers to say definitely what they like best; all they say at present is that they want evenness in every way, that is to say, good, strong, pure rubber of good appearance and colour. It doesn't matter whether pale or amber so long as it is bright-looking and transparent. This is of course rather difficult to get owing to the strength varying so, probably due to difference in the age of the trees. When the quantity of plantation rubber has increased considerably, buyers will be able to pick and choose the stronger and better lots, and I have no doubt that there will be a considerable difference in price between the two qualities. The reason why all the fine fetches within a fraction of each other is because the buyers have to take good and indifferent alike, the quantity offered at one time not giving them the chance to pick out the stronger and better lots. Planters ask if it would pay them to keep the rubber from old trees separated from the young, for, undoubtedly, the strength of the rubber is in a great measure due to the age of the trees from which it is obtained, and I think most of us are agreed that this is so. After seeing the samples from old trees at the Exhibition I do not think it would pay to keep the two separate at present, but I have no doubt that in the near future, when quantities increase, it will. With regard to the tapping of young trees, it may not do the trees themselves any harm, but it is likely to lower the high standard for which you are all aiming. I have every hope and have no doubt that plantation rubber will be the standard of the world, not only in purity, but in strength and all the properties for which the Amazon rubber is noted. But I should not decide for certain that, when your trees are old, all the rubber will be stronger, for I have seen some biscuits from 21-year-old trees very weak.

The Discussion.

Dr. Willis said he thought that they had just listened to a most interesting lecture from Mr. Devitt. The subject of packing rubber to London was of very great importance to all planters. He should like to call special attention to what the lecturer had said about the mixing of rubber. At present the amount of rubber that went to London was so small that it did not very much matter. He had occasionally seen people

mixing biscuits from very young trees with biscuits from very old trees. He had found two biscuits in the same lot, one of which was good and strong, and the other, which was much weaker and could be pulled in half with some effort. As soon as the market got large quantities of their rubber it would be sold, not on the fact that it was Ceylon rubber, as at present, when people wanted to buy it chiefly for experiments, but on the strength and physical qualities of the rubber; and the sooner they learned to keep their rubber of a fine grade separate, and not to mix it, the better. As regards that, he said a good many people graded their rubber at present, but he thought the most of that grading at present was done according to colour and other fairly obvious properties, because the few analyses which had yet been made to test the strength and so on had shown a most extraordinary difference in the various kinds of Ceylon rubber. There were some figures published in the *Tropical Agriculturist* the other day, giving tests made in America, and it was shown that they had a tensile strength from 85 to 145. That was a considerable difference, but they did not know what it was due to. Rubber from older trees, it was obvious, was the stronger rubber, and he gathered from all the remarks made by these gentlemen from London that it was strength that was the main quality, and he therefore personally thought they would have to come to some machine like that exhibited by Mr. Carruthers for the purpose of testing the rubber for strength. The London people at present went a good deal by colour because they were a little afraid that the rubber, some of it being very dark, might not be pure, but he thought that after some time, as in the case of tea and cocoa, they would get to know that the Ceylon planter did not adulterate his products, and that it was unnecessary to look for impurities in his rubber. As he had said the other day, now was the time to experiment with the making up of rubber for shipment and the shipping of it in different ways before the market had got wedded to one particular way. He hoped there were many proprietary planters, who were comparatively independent, who would take the opportunity of experimenting in shipment. They might lose a penny or two at first, but important knowledge would be gained. He had seen people mixing tacky rubber, too, along with good rubber. A planter had said the other day that if they put a piece of tacky rubber in the middle of a block and squeezed it nobody would recognise it. But Mr. Bamber had told them a certain type of tackiness was infectious and it might spoil the whole block. It was important not to mix tacky rubber with good rubber. It should be kept separate. It might be possible to pass it off at first, but

before long the buyers would be sure to find out, and the price of the whole lot would go down. With regard to shipment, Mr. Devitt inclined in favour of block, and most of them who had seen the Lanadron blocks in the Show were inclined to agree with him. These blocks contained 25 lb. of rubber, and it was obvious they occupied much less space and consequently cost much less in shipment; and they exposed less surface to the air than did a similar weight of biscuits, and there was less oxidation going on. They were beginning to know that oxidation of the surface had a considerably deteriorating effect. At the same time the Lanadron blocks were probably too large, or at any rate too thick. They have to be cut up—a work of some labour—before they will go through the rollers of the macerating machines.

Points in Packing.

Mr. James Ryan: I should like to ask Mr. Devitt how rubber arrives in London at the present moment—the form of package which he recommends most, and the condition of scrap, biscuits, and crepe on arrival. I want to know, for example, whether these biscuits on the voyage, by contraction or agglutination, stick together, and what process is used for removing them when they do arrive; and what package does he consider sufficiently strong for a cwt. or a half-cwt. He warned us against using weak packing. I wish to know what package he recommends.

Mr. Devitt: These biscuits arrive in an agglutinised mass. I do not think you will find any way in which the biscuits will not be stuck to a certain extent, but they can always be pulled apart unless there is some tackiness. As regards the case, I think most planters agree with Mr. Campbell, who said the other day that rubber was worth a good coffin, and that was why he did not like packing it with a piece of sacking round it.

Mr. Ryan: That does not answer my question. The question I asked is, How does rubber now get to London?

Mr. Devitt: We get it in cases of from 20 to 400 lb. weight. Most of it comes over in ordinary tea chests.

Mr. T. Villiers: Might I ask, having all these different sized packages, on what principle you draw your samples?

Mr. Devitt: They open them at the wharf and take out a fair average sample.

Mr. Villiers: If there is a 20-lb. case and a 4-cwt. case, what sample would they take from each?

Mr. Devitt: Generally about the same. We generally get up 2 or 3 lb. of each, but where it is a large lot of, say 20 large cases, we get 5 or 6 lb.

Mr. VILLIERS : Then there is no fixed principle as in the case of tea ?

Mr. DEVITT : No ; it is a fair average sample that is taken. If the rubber is not manifested in different grades they are assorted according to quality.

Mr. VILLIERS : In the wharf ?

Mr. DEVITT : Yes ; there is no fixed weight they use. They draw a fair average sample at the wharf.

Mr. VILLIERS : Who decides the amount of the sample ?

Mr. DEVITT : The old, experienced men.

Mr. VILLIERS : From the brokers or from the merchants ?

Mr. DEVITT : They are not brokers. It has nothing to do with them. The people at the wharf are responsible.

Mr. RYAN : Well, are you satisfied with the general condition of the packing of rubber in Ceylon, and as it arrives in London now ; do Ceylon packages arrive in good condition ?

Mr. DEVITT : Yes, as a whole, but we have known cases where a thin veneer was used, and they have come in a broken condition. We have even heard of them being manifested as broken.

Mr. RYAN : Then we have a disease. What is your remedy?

Mr. DEVITT : Not to use these thin cases.

Mr. RYAN : Do you think the ordinary half-inch tea package sufficient, and what form of clamping and nails do you recommend ?

Mr. DEVITT recommended the ordinary tea chest with an iron rim round it.

Mr. RYAN : I take it if you used the ordinary tea chests the weight of rubber would be three times that of the tea chest, especially if it was concentrated to the block form. It contracts on the voyage, and is constantly edging in and out and in spite of that you are wholly satisfied with the condition of the arrival of rubber in London.

Mr. DEVITT : It is not in many cases it is packed in these thin wood boxes, but we have known cases and we do not want planters to go on using them.

Mr. RYAN : Can you suggest any improvements ?

Mr. DEVITT : I think yours is a very good idea for binding them round with canvas, but they would have to be unpacked in London at the planters' expense.

Mr. RYAN : Quite so. I can easily improve on that, but the point is whether your difficulties were that it was difficult to reopen and difficult to unpack these packages, because that can be got over by a different method of tying and pleating. Do you recommend the addition of some disinfectant to the outer surface, such as formalin ? Would that be an objection to the trade ?

Mr. DEVITT : I think it would.

Mr. RYAN : Would they be able to detect formalin if applied externally to the package ?

Mr. DEVITT : I think not.

Mr. RYAN : Then you have spoken of paper and warned us against its use. You spoke of plain paper. Have you had any experience of waxed paper ?

Mr. DEVITT : I only saw it in the Exhibition, and it seemed very satisfactory.

Mr. RYAN : How about the ventilation of the case ?

Mr. DEVITT : It will get quite enough I think. There is no need to make special ventilation.

Mr. RYAN : Mr. Brett complained that any form of pressure applied to the rubber in the form of sacking seemed to have a deteriorating effect on the rubber.

Mr. DEVITT : We get rubber from other parts of the world in bales, and when it is being cut it has to be cut right through sacking, which has become attached to it ; and the sample is sent up in that way.

Mr. RYAN : It seems to me it is perfectly evident you must have some simple substance to put in between the packing and the rubber. How would thin strips of veneer do ?

Mr. DEVITT : I think that would get over the difficulty.

Mr. RYAN : My object is to try and elicit from you some idea as to what you would suggest would be the very best method of packing. We are not going to spoil the ship for a hap'oth of tar, but at the same time we have a natural desire to economise. Proceeding, he said they would like to get information on this point by experiments. He would like Mr. Devitt to take home some rubber packed in various ways and report to him and those individuals that would be associated with him on the way it arrived in London. He should like to send it home by a way that it would reach after Mr. Devitt had arrived home himself, if necessary sending it round Cape Horn. He should like to have it knocked about a good deal so that when they got Mr. Devitt's report they might know whether they were not groping in darkness or walking in the light.

Mr. DEVITT : I cannot tell you how your packing will answer until I see it arrive in London.

Mr. RYAN : I am not talking specially of my method of packing, but any packing whatever.

Mr. DEVITT : The blocks we received so far have been in beautiful condition. These were packed in a strong case. They were stuck together, but there was no actual tackiness. We took them from each other with a crowbar and they were quite satisfactory. The case was of half-inch wood.

Dr. Willis said that with regard to the packing of block rubber with sacking round it he saw some planters on the previous day examining the package Mr. Ryan had prepared in the Show. One planter held it up and let it drop and it immediately bounded right out of the window. If they were going to have their packages leaping and bounding all over the docks there might be some disadvantage.

Mr. Smithett: What Dr. Willis has just said about rubber bumping is frequently true, and I think that planters have to remember that the average dock labourer in London does not care what happens to the package he is dealing with. What he chiefly thinks about is of being able to get off to his home as soon as possible, or something of that kind. I think that, considering the great amount which we hope in the near future you will be able to send to the market, it will not be worth while, as Mr. Ryan has said, spoiling the ship for the sake of a hap'orth of tar. I don't know the actual cost of the half-inch tea chest, but considering that you can get ½ cwt. of rubber into one I don't think it will be so great as to detract much from the cost of the rubber. In regard to packing in bales, as Mr. Devitt has said, the fibre inside the packing is very liable to attach itself to the rubber. I have seen several consignments of scrap sent home in sacks in that manner, and it was very noticeable that the whole of the outside of the scrap was covered with small fibre from the inside of the sack.

Mr. Devitt: It is very desirable that you should get uniformity as to the size and weight as far as possible. From the Amazon they have the standard size of 32 cases to the five tons. As the quantity exported gets larger it would be advisable to fix upon standards of weight.

In regard to the question of sampling, planters rather seem to have an idea that brokers are making something out of the samples, but I may say that every pound of rubber that is taken is accounted for. If the buyer wants the sample he pays for it. If not, it is returned to the bulk before being weighed.

Mr. Zacharias: Having brought over some cases from Singapore, we have got some good samples of what rubber looks like when it arrives in London. If you look at our rubber you will find that the sheets are all glued together; but there is no tackiness whatever. In fact, the judges were so well pleased with some of them that they awarded them honourable mention. They were very thin sheets, and by the time they arrived, although they had filled the packing cases, they had contracted into a small block. There is one point I should like to have an answer to, and that is relating to block rubber. All cultivated rubber in any other form, when

pulled, will never go back to the same place where you started. It always becomes longer by being stretched, whereas, I understand, fine Para never does that, but it comes back almost entirely. I notice that block rubber stretched in the same way will go back to the same size. I have noticed that in the Lanadron blocks, which won the gold medal, and also in Rambong blocks. I should like to know if my impression is correct, if that would show that the pressing of the crepe adds strength ?

Mr. DEVITT : I noticed that this morning. I tried some of the strips cut from the blocks and I was surprised at their resiliency. On the other hand, Mr. Wright showed me biscuits from $29\frac{1}{2}$-year old trees and they went back to the same size as before after being pulled.

Mr. HERBERT WRIGHT : They were one-eighth of an inch in thickness.

Mr. DEVITT : Yes, that is so.

PROFESSOR DUNSTAN'S STATEMENTS.

Mr. HERBERT WRIGHT : I should like to bring forward one matter to which Mr. Devitt has referred. That is the relationship between the physical properties and chemical composition of the different kinds of rubber. In his recent speech at the British Association Professor Dunstan said that the physical properties of raw rubber are to be correlated with the chemical composition of the substance itself. To some extent we can say that that logically applies to the different rubbers if we regard the rubber from different species such as Para, Castilloa, Landolphia, Ceara, and so on, and again we can say it holds good if we compare rubbers from Castilloa trees of different ages. It has been pointed out that three-year-old Castilloa trees possess 55 per cent. of resin and eight-year-old trees possess only 7 per cent. That statement of Professor Dunstan's is therefore apparently applicable to the rubber obtained from Castilloa trees of different ages, and in a comparative sense to rubber obtained from different species ; but when we come to consider our own rubber, Para, it is rather difficult to see a common agreement. I took the judges over some samples of rubber in the laboratory at the experiment station. Some of it was from trees two years old and others from 3, 5, 7, 10, 11, and $29\frac{1}{2}$-years old ; and the difference in the physical property was manifest. The ease with which some of the young rubber was torn up was remarkable, whereas, as has been pointed out, the rubber from the $29\frac{1}{2}$-year-old trees even our youthful judges were not strong enough to break. We were lucky enough to get a snapshot of them with the ordinary sized biscuit stretched

out to 2 feet 9 inches between them. The judges have divided the biscuit between them and are taking it back to England. Therefore, we have in Para rubber a definite and conclusive difference in physical properties, and yet, as we know, the duplicates of the rubbers to which I refer have been shown by Mr. Bamber to have approximately the same chemical composition. The results of Para practically contradicts the statements of Professor Dunstan, and I should very much like to know whether it is intended to apply only to rubber of different species or rubbers from trees of different ages with which we have no acquaintance. It certainly does not apply to our own Para rubber.

Personally, I think it might be as well if we turned out, as Mr. Ryan says, a uniform sample year by year from different estates, because we are now simply starting from the very bottom. The trees can never be younger. The age will increase year by year, and with it the quality of the uniform sample, and this will be appreciated in London.

The Mixing of Latices.

Mr. Bamber : I should like to call attention to one point. Mr. Devitt referred to keeping the stronger from the weaker rubber when packing, but personally I don't think that is the time when you want to keep them separate. I think myself the latex from young trees as they come into bearing ought to be kept separate and coagulated separately, and the biscuits made from the different latices kept separate. I have seen cases where a few young trees have been tapped and rendered a considerable amount of rubber from older trees weaker, and it seems a pity to spoil a good thing in that way when you can keep the latices separate.

Mr. Ryan : I entirely differ from Mr. Bamber. If you have enough to separate by all means separate, but if you have small supplies it would pay much better to bulk the latex, and I think you will find that the little good rubber will leaven the lump. I am not talking from the point of theory but from practice. It is better to have uniform samples from estates than to have little driblets coming in that will vary a few pence per lb. in price. You will find that you will get more for your rubber and you will keep your superintendent from the verge of delirium tremens. You must have uniformity, and bulking the latex is the way to secure it. It is interesting for Mr. Bamber to separate latices, and measure them by cubic centimetres and find out the specific gravities, but the average superintendent has to take the stuff the coolies bring him, and if he starts sampling and separating and fiddling about, that way madness lies.

Mr. BAMBER, replying to Mr. Wright, said :—With regard to the comparison of Para rubber from the analysis of strength, the reason they had not been able to do that at present was that they did not have a correct solvent that would extract the solvent matter from the true caoutchouc. They used acids which, after some hours, would remove the whole of what they called resin, but in the residue that was left there was no doubt some other compound which was not true caoutchouc—at least it had not the elastic properties of caoutchouc. They would imagine that if they took good rubber and bad rubber and extracted the weaker matter they should find that both samples were the same strength, but he found the residue of strong rubber was much stronger than that of the weak rubber. In regard to the mixing of latices he could not quite agree with Mr. Ryan. He knew that a very small amount of weak latex would injure, or was very liable to injure, a large amount of older latex. They had several estates with trees of several years old. As they went on in some years they got in a lot of younger rubber. If the latex was mixed with that of the younger rubber they spoiled a good sample they had turned out, and, perhaps, that might injure their name. He was only referring to later on when they had their rubber in bearing. He did not think it would be necessary to separate the latices after eight years as he thought there would be a fair uniformity in strength, although that ought to be a gradual matter, as the trees grew older ; but he did think it was worth while taking the precaution while much of the rubber was young to keep the latices separate. It might mean a little trouble to the planters, but it was only a few tappings from the trees, as they came in year by year. That would be new rubber, and it would be necessary to keep it separate for, perhaps, two or three months, until the trees had got thoroughly into the tapping.

Mr. WRIGHT : Following up this point, I should rather like to ask Mr. Bamber whether he thinks that, in the case of other rubbers, any physical test is likely to be devised which will indicate the chemical composition of the raw material. If Professor Dunstan's statement is correct that the physical properties can be correlated with the chemical composition, there is some ground for anticipating that it may be possible by a physical test to get some indication as to the quantity of resin or other ingredient in rubber. I should like to ask Mr. Bamber whether it is practicable. Is it scientific ?

Mr. BAMBER : I don't think any physical test would give you the amount of resin. We will have to find a solvent that will remove the weaker compounds of the rubber. There are other physical tests now employed to determine the resiliency.

but it absolutely cannot give you any idea of the chemical properties. For instance, Castilloa rubber has a very large percentage of resin. I do not think, from the results of the needless test that is usually employed, you can draw any deductions as to the amount of resin. It is possible some test may be devised that will give you the best quality of the rubber, but, at the same time, I do not think it will ever point out what the chemical properties will be. As far as I can see Para rubber will never contain more than 3, 5, or 6 per cent. of resin at the very most, and we are sure the physical test would show the difference between one and two or even five per cent.

Erasion of Estate Marks.

Mr. Ryan asked how they were to identify their rubber when it arrived in London as being the original samples shipped, inasmuch as there was a method which was in daily use in some districts for removing estate marks from biscuits, and which, for obvious reasons, he would not describe ; but it was a very simple and effective one. If they were to go on producing biscuits it was evident that they would have to devise a more permanent method of stamping rubber than the present one of impressing a die on it. He thought possibly it might be effected by using a sinking die to raise the rubber, because he thought it would be more difficult to reduce this without leaving an impression than to raise the sunken part to the level of the surface as was done at present. They might have a press with prickles on it very much like the method used in the Army and Navy stores and by many firms in London for marking bank notes passing through their hands. He gave that as a special warning to the Kandy district, where the wily Moorman had already devised a method of taking their biscuits and selling them in the open market.

Dr. Willis said it might be interesting to several people to know that he had had it illustrated in that Exhibition that the estate mark could be completely removed from biscuits with the greatest ease.

Mr. Devitt said he had seen several biscuits with the name cut out and cut into several bits and put into the scrap. With regard to sending large blocks of rubber, he knew a case of one importer of Para from the Amazon who shipped down 100 tons with his name stamped on the rubber and when it got to one port it was found that it only weighed 50 tons, though the number was exactly the same. At some place of stopping they must have taken all the packages out and replaced them with others with the same marks on.

Mr. SMITHETT : Do I understand Mr. Ryan to mean that the brokers are to test every estate mark ?

Mr. RYAN : Oh ! no ; this is directed against thieves in the Island. We have people who have a few trees that give a remarkably high yield, and of course we know perfectly well where the rubber comes from. The idea is to put a stop to the thieving of rubber, and that again touches another point which will appeal to planters. We have a Prædial Produce Act. I remember that the tea industry was getting pretty old before we could get that Act improved so as to make it workable in the case of thieving of green tea leaves, or, very often, of made tea. Our friends, the cocoa planters, have had even more trouble, and I think it is just as well to start early in rubber so that we may be ready and protect ourselves in time. We should approach Government and have legislation to protect ourselves in every possible way before our contracts are of a sufficient size to make the losses material ones. I remember in the case of coffee a few acres used to produce extraordinary prosperity and plumpness in the neighbourhood, and when the coffee crash came it gave the greatest blow to the natives in the neighbourhood of coffee estates because they could not steal the European coffee. They were reduced to a state of penury by not being able to steal our coffee, which was pitiable to witness.

A vote of thanks having been passed to Mr. Devitt for his paper the meeting ended.

Rubber in London.

By Messrs. SPENCER BRETT AND C. K. SMITHETT.

Dr. J. C. WILLIS presided.

Mr. BRETT said : Ladies and Gentlemen : The subject of rubber in London is rather a large one to concentrate into the space of a few minutes, but we have done our best to pick out the points most likely to interest planters and hope we shall meet with some measure of success. London has for a long time been a very important centre of distribution for rubber, and its position has lately been improved in this respect, the headquarters of most of the important buyers and firms handling the product being now centred there. In greater or less volume it may be said that all grades of wild and cultivated rubber are to be seen on our market, and as the number of the different kinds runs into hundreds London offers an excellent opportunity for comparing the various grades. The actual commercial value of crude rubber varies from a few pence per pound to nearly 6*s*. according to the amount of caoutchouc contained in it, the nature of the foreign substances, and for other reasons.

It may be interesting to mention that I have myself carried out analyse of the contents from carefully-selected standard samples, and I find that fine Ceylon biscuits contain, on an average, between 94 and 95 per cent : hard fine Para 77·67 per cent.; soft fine Para 76·55 per cent.; hard extra fine Para 73·63 per cent.; soft extra fine Para 70·75 per cent.: Negroheads 63 per cent.; Cametas 44·93 per cent., whilst the lower grades contain down to about 40 per cent. It can be seen from these figures that there is a very wide difference in the various grades of exports of Para.

These have in the past amounted, roughly, to one half of the world's total production, and until the Eastern plantation product came into the field the finer qualities of Para always realised higher prices than anything else. It may be said that Para, *i. e.*, South American rubber, was the foundation on which the industry was built, and the standard methods of compounding and manufacture that have been carried out were based on the character of these grades. The different processes in use have largely been arrived at after many years of experiment. The behaviour of different kinds of rubber in manufacture is so varied and complicated that, as new grades have from time to time come on the market, a considerable period has elapsed before manufacturers have worked out the best treatment of them, and thus been able to decide their standard value. Under these circumstances, it is only natural that, until your Eastern cultivated product has been freely experimented with by the bulk of manufacturers, its intrinsic value is unlikely to be fully understood. In face of this we have the astonishing fact that, even from the days when only one or two consignments of a few pounds each in weight came on the market per month, say five years ago, a premium was paid over the prices of the then fine standard American Para grade. Supplies have been short, and prices have appreciated very considerably, roughly 100 per cent. in this period, and we still find that the premium for Eastern plantation grades is readily obtained. The obvious explanation is that the buyer of fine plantation rubber receives from say, 10 to 50 per cent. more caoutchouc for his money than the buyer of other grades, but unless your cultivated product were well suited to the manufacture of some expensive goods, it stands to reason that its use in the factory would not be profitable; and not only is it found worth while to handle the new grade at a much higher initial cost at a time when prices are cut to the last degree, but actually you have a number of manufacturers who consider it advisable to spend large sums of money experimenting with it, when they can procure at a less cost a rubber for the preparation of which all their mills and

machinery have been designed, and furthermore a substance, which has from the beginning of the industry supplied all kinds of goods for which rubber has been used. Under these circumstances is it to be wondered at that the manufacturer should hesitate before deciding that he is justified in expending large sums of money in experimenting with an article the nature of which is as yet imperfectly understood, at a time when, owing to market conditions, he is only just able to get a margin of profit when using a lower priced rubber, which he has proved by experience to give very satisfactory results? I myself know many instances when manufacturers have taken the other course and decided that the present is not the time to start experimenting with the new grade owing to its high cost—but they have quite made up their minds to give it a thorough test when conditions favour it. In the meantime those more progressive people who have tried it with good results, and are now regular consumers, have all the time been improving their treatment of it, and there are already people who say that not only can Eastern plantation rubber take the place of South American Para, but they themselves are using it in their own factories for the severest test to which rubber is subjected. It is a difficult matter to obtain an inside knowledge of the nature of the rubber manufacturer's business; a great number of them, whose successful career has in some measure been due to the efficiency of their private processes and methods of preparation, are naturally somewhat jealous of them, and are disinclined to expose them to the critical eye of any one engaged in the same industry. I very soon realised, however, that much useful information was to be found by getting an insight into this part of the industry, and after some difficulty I succeeded in getting taken over some of the largest mills and factories in England. One of the first things that struck me after this inspection was the very large amount of capital and labour that might be saved in the first stages of manufacture by the use of the fine pure grades of cultivated rubber, but a point of great importance that must not be overlooked in this respect is that the full benefit of this could not, of course, be felt until large supplies are always available.

One of the more important changes that has recently been taking place in the industry is the increase in the use of scientific methods in the factory. From one cause and another it is now generally accepted by manufacturers that a laboratory in their factories with a well qualified chemist is quite essential. Only a few years ago very few of even the larger makers had them, but now you will find that in many cases the laboratory forms a very important part of the factory, and there are

many who hold that before long analysis may play an important part in the buying and selling of crude rubber. To get an idea of the effect of the rapid rise in prices of rubber on the manufacture, it is interesting to find that on account of the adulteration that had sometimes to be resorted to in order to complete contracts extending over long periods without heavy loss, departments which sent out tenders for large orders have on account of the unsatisfactory nature of certain goods supplied, been compelled to make their conditions far more stringent, and just before leaving London I heard of an important tender having been put out, one of the conditions being that the resin contents were not to exceed four per cent., the idea being to necessitate the use of a large proportion of fine Para. In this connection it is interesting to note that the finest Eastern plantation Para would roughly be on about the same footing as fine South American Para on account of its small resin contents. In conclusion, Gentlemen, I can only say that we in London mean to continue to do all in our power to promote and extend the uses of your product, and I think I am quoting the general opinion when I say that you are to be heartily congratulated on the splendid progress that has already been made in the growth, preparation, and quality of cultivated rubber in the East. I am sure, with the extremely capable and energetic people you have out here in these gardens, and among the planting community to devote their time to the welfare and development of the industry, there can be very little doubt that the future of the industry will be a bright one.

Mr. Smithett's Lecture.

Mr. Smithett : Dr. Willis and Gentlemen: It is rather trying for me to have to follow Mr. Brett, because Mr. Brett has taken away a good deal of the material that I might have used. The relative qualities of the different grades of rubber put on the London market has been dealt with by Mr. Brett very ably, so I should just like to say just a few words as to the form of rubber we should like you to send us. So far you have consigned to the home market an article which has gained a reputation for its purity, and the present premium over fine hard Para, although not now at the very high point obtained early in 1905, is due to the purity of Eastern plantation rubber. So the first point I wish to impress on you is to maintain the reputation you have gained for yourselves. In one feature, at any rate, fine hard pure Para is in most cases superior to plantation rubber from Ceylon and the Federated Malay States, and that is in strength. The question I put before you is this : How can you obtain that strength without reducing the

present high standard of purity? It is essentially a question for planters to answer, and the solution can only be obtained by experimenting. The able scientists you have in Ceylon will, I am sure, do their utmost to help you. I do not think we in Mincing Lane can help you to a solution. It is not in our line of work. The question strikes me: Do you tap your trees too early? I know there is a desire to get into the market as soon as possible, and I am afraid that in some cases trees are tapped rather too early. Remember, in the forests of rubber in the Amazon districts trees are very often not tapped until they are over 30 years old, to take a very moderate figure. I believe that in Ceylon and in the Malay States the tapping of trees begins at six years and sometimes less, which makes it worthy of remark that some of the rubber in this Exhibition which received the highest awards was from trees 10 to 15 years old; while in the case of the Ceara rubber from Rangbodde, which obtained a prize, it was from trees 20 to 22 years old. The other day we were shown rubber from trees from Henaratgoda about 30 years old, which showed a very good tensile strength as far as it can be obtained without the proper appliances, and which compares very well with fine hard Para. Plantation rubber is as yet in its infancy of course, but it is never too early to begin trying to improve. Bad reputations are difficult to be got rid of; so do not let your rubber acquire a reputation of being weaker than fine hard pure Para. We in London look forward to the day in the near future when plantation rubber will be one of the predominant features in the market. But "strength" is a necessity. I mention this question as we all in London want Eastern plantation to supplant wild rubbers, at any rate to a very substantial degree. Another question is moisture. There is more moisture in fine Para than in your rubber. Do you extract too much moisture? It is a question for scientists to answer whether maintenance of moisture does not contribute to greater strength. I suppose the question which we have been asked most frequently since we have been in this Island is, in what form do we want rubber in London? I think we are all agreed on this point. Let us see some more block rubber, but a word of warning is necessary. Block rubber is still a new idea, and while the shipments from Lanadron estate have realised 2*d.* to 2½*d* per lb. above fine plantation, it is not an established fact that if all plantation rubber came in block form that you would all obtain a higher range of prices. The consignments being small, they are readily bought up now.

The samples of smoked rubber which we have seen have interested us greatly, and we look forward to further experiments in this direction. The samples from Arapolakande were

very interesting and compare favourably with fine Para. Smoking is an essential part in the preparation and curing of fine hard Para, so samples of the rubber cured in a very similar manner would be of great interest. It would be interesting if some of you, Gentlemen, would try curing a little of your rubber in the same way, because you can carry out the operation with a greater degree of purity than they do on the Amazon. Buyers are now getting used to fine crepe, but still some leave it alone ; but, as I told you the other day, I think fine crepe will sell well when all the trade will buy it. I do not think that manufacturers are prepared to accept estate washing as sufficient for manufacturing. They said washing was one of their perquisites. I do not mean that the Ceylon planter never washes at all. I confine my remarks to the washing of the rubber. Perhaps, some planter will answer this question. Does the time saved by making crepe justify the loss in weight in the washing process ? I do not know what the loss in weight is, but you, planters, no doubt, can ascertain that. Inferior grades of crepe were, when we left London, somewhat under a cloud and difficult of sale, buyers not being able to estimate the amount of the impurity in it; but from recent reports I gather that the demand is improving somewhat.

As regards biscuits and sheets, the former, I am convinced, will, when the industry develops, have of necessity to be abandoned in consequence of the length of time and amount of labour in preparation. While you are dealing with pounds, the difference may not be so great ; but later, when you deal with tons instead of pounds, you will realise it. However, while you can still send biscuits and sheet you will, I think, find buyers. In conclusion, I may say the industry regarding actual plantation rubber is young ; so, until shipments come in more important lines, it would be unwise to definitely decide on any one system of preparation for the London market. We in London watch with keen interest the development of this industry, and I can only say we like Eastern plantation rubber and want more of it. We hope its purity will be maintained, and, perhaps, you will find a way to improve its strength. We in London hope that nothing will happen to make the prospects of good supplies less hopeful than they are now.

Mr. RYAN said he would like to ask Messrs. Brett and Smithett a question *a propos* of the prices of rubber in London. He took it that Ceylon biscuit was just now getting prices which might be taken at 6*s*. per lb., to judge from the information just given him, which was 6*d*. better than fine Para. Now, Mr. Brett had told them that there was a difference of 20 per cent. in the matter of purity. Taking it at 20 per cent., 20 per cent. of 5*s*. was 1*s*., which meant that they were

getting only 6*d.* for their greater purity, which was worth 1*s.* Whether it was due to superstition or not, it was undeniable that the London manufacturer was not prepared to give the Ceylon planter the full benefit of their purer methods of manufacture and greater purity in the form of hard cash, and that was really what they wanted.

Mr. BRETT said that in preparing his remarks he had made a special point of describing how it was that up to the present plantation rubber had not received the full benefit of its remarkable purity, and he had gone further in stating the conditions that must be fulfilled before the full benefit could be obtained. He was sorry that in one quarter at any rate his efforts had apparently been unsuccessful. He went on to assure them that there were several reasons for the difference in prices, reasons which were far more tangible than superstition. In the first place, it must be borne in mind that the figures he had given them were not the figures of the actual "loss in washing," and therefore comparisons based on them would be valueless. While fine South American Para might possess only 77 per cent. of pure rubber, it did not follow that the manufacturer was going to lose 23 per cent. in manufacturing. As a matter of fact, a rough calculation showed that the average loss in the factory was only about 15 per cent. That was one point of importance to remember. The other points were rather more complicated, but he might say that, in the second place, the industry was, as he had been trying to impress upon them, very young. The methods of preparation were still not perfected. Some methods had taken years to perfect, and until the manufacturers had had time to thoroughly understand plantation rubber they could not arrive at a proper standard of value. In the third place, they knew that the imports of plantation rubber were so far extremely small in comparison with the world's consumption. To give them some idea, he might remind them that last year's exports of plantation rubber from Ceylon and Malaya were only 171 tons in comparison with the total production of 60,000 tons, and when that was spread over the world they would, he thought, agree with him that the quantity of plantation bought by the manufacturers was yet too small for experimenting with on an adequate scale and for commercial uses generally as well. So that it was only reasonable to expect that some time longer must elapse, and much larger quantities be handled by manufacturers before they could expect all the qualities of their produce to be fully recognized and appreciated.

Mr. BRETT said he might further add to his remarks by stating that there were many other considerations than those he had named already which affected the question of the prices.

One consideration raised the all-important point which had been widely questioned and upon which a definite verdict still remained to be passed, namely, whether the nature of plantation rubber was such as would enable it at any time to supplant fine South American Para. Mr. Brett was himself very hopeful about this, and the Exhibition had greatly strengthened his hope. At the same time, it was quite impossible at that stage of the industry to prove it. Manufacturers naturally went by results, and until they had definitely decided this question they would not be prepared to pay a high premium for grades which they did not yet fully understand. Ceylon rubber was being experimented with yet. There was not the slightest doubt that once it came into consumption on a large scale, and was found satisfactory after severe tests extending over a long period of time, many manufacturers would handle it in place of fine hard Para. Then, and not until then, he was fully convinced, would the Ceylon people get the full advantage of the superiority of their product.

Dr. Willis said that it seemed to him that now was the time for experimenting with the preparation for the market in regard to the best form and the like. Both Mr. Brett and Mr. Smithett had told him that at present the market was in a fluid condition, and that was therefore the best time for trying experiments with success. Suppose they went on making biscuits. Biscuits would be on the market in large quantities. People would be so accustomed to the biscuits, and the manufacturers would be so wedded to them, that they would be inclined to look askance at anything else in the way of form. But now, while they were only making small quantities, was the right time for experiments in the direction of other forms. Some people thought that they should go on making biscuits now while biscuits found a ready sale, postponing experiments in other forms until buyers were dissatisfied with the biscuits. He differed from that view. Now was the best time to make the experiment in other forms—sheet, block, and the many other forms in which rubber could be placed on the market. He invited remarks on the lectures. The subject was one of very great importance. They had heard a great deal from the broker's point of view. They would like now to have remarks from the planter's point of view. There were several planters there who had the right to give them their views.

Mr. Herbert Wright said that Mr. Smithett had brought forward the question of manufacturing crepe and had pointed out the disadvantage that in that process a certain amount of the material was necessarily lost. But, apparently,

Mr. Smithett had forgotten to remind them that crepe rubber, as Mr. Smithett had convinced him the previous day, was the only form which could be guaranteed to reach the London market free from mould or tackiness. He understood from a conversation with the judges the previous day that during the past few months there had been a large increase in the quantity of biscuits and sheets which had arrived in London in a mouldy or tacky condition, but the appearance of crepe rubber had during the same period been quite free from the same defect, no mould or tackiness in crepe having been noticed.

Mr. SMITHETT said Mr. Wright was quite correct in that statement. They did say that they never noticed mould appearing in fine crepe. Still, the question that he would like to ask them was, whether the loss in the process was justified by the saving of time. He wished to know what the loss was in weight. From the planter's point of view, was it preferable, in view of that loss, to make crepe rather than any other form?

Mr. WRIGHT said it was much easier to manufacture rubber in that form. The case was comparable with that of cocoa. They knew that in other countries—South and Central America and the West Indies—they did not wash their cocoa but sent it home simply sun-dried. They in Ceylon washed their material, because they wished to keep up to the higher standard of purity. If purity could be associated with freedom from that important defect of tackiness, be thought that would ultimately be of value to the Ceylon planter.

BLOCK RUBBER.

Mr. RYAN said it took longer to make a given finite biscuit than to make a given finite piece of crepe. That morning, for instance, they had seen crepe made in 20 minutes. He had carefully timed the latex from Macadam's centrifugal machine, and thence through the Michie-Golledge machine, and through the Federated Engineering Company's machines, and so on. He had timed it from start to finish, and that whole time was a fraction under 20 minutes. With the vacuum process the time would be shortened, and the resulting rubber was equal, if not superior, to any other rubber in the Show. They took some vacuum dried crepe and subjected it to a pressure of 3 tons to the square inch, and the result was a block which Mr. Campbell, of Lanadron, himself considered superior to the block which had taken the gold medal. The question of time answered itself. The question of ocean freight also answered itself, because it involved from one-half to two-thirds of the ocean freight necessitated by any other form. The question then resolved itself

into whether screw pressure, which produced a block out of crepe, improved the quality of the rubber—they thought it did—or whether it deteriorated it. The conclusion they formed was that pressure improved the elasticity of the rubber, and elasticity and resiliency were points which manufacturers looked to. Those points could only be determinated by experiment. He was sorry Mr. Carruthers could not show them the very ingenious machine which he had invented to test the resiliency and elasticity of rubber. If Mr. Carruthers would tell them the broad principles of that machine they would listen to them with great pleasure. Rubber was largely used in electricity for its resiliency. If they could secure its commercial purity, they might hope to secure electrical resiliency. They were going to secure all these things. Let them make quite sure of that. They would get all these things soon, in good time before all the rubber now planted came into bearing.

Mr. Carruthers: I do not think I have very much to say except that I wish very much on behalf of the Further East to thank the two gentlemen, Mr. Smithett and Mr. Brett, for the frank way in which they have told us their requirements and given us sound advice as to how we can please our masters, the manufacturers. As far as I can gather, the matter put into a nutshell is that we must go in for purity, and if we go in for purity we may expect not only to be able to keep up the present high standard but improve upon it, and in time when manufacturers have more experiences with our Para we may rival Para. As to the machine Mr. Ryan has referred to, two years ago I was interested in trying to devise some simple machine which would test resiliency and elasticity of rubber; and I brought it over here as I thought it would interest visitors to the Exhibition. Unfortunately, ever since I have arrived here I have practically been judging from 8 o'clock in the morning till almost dark, with hospitable functions interspersed and other things, and these have not left me time to put it together, but I promise to do so tomorrow, so that any one can see and be able to judge for himself.

Mr. Brett said there was one other thing besides the purity of their rubber which they must seek for, namely, the still more important property of fine rubber—strength. It ought to be easy for them to find out how to obtain that; because it was a point for scientific men and they had there the very men capable of deciding how it could be done, and they, he had no doubt, would do so before long.

Dr. Willis then moved a vote of thanks to Messrs. Smithett and Brett for the very interesting papers which they had given them.

CHAPTER VIII.

THE RUBBER EXHIBITED.

We may now pass on to the consideration of the rubber exhibited, which was most carefully examined and valued by three representatives of the principal firms of rubber brokers in London.

LIST OF EXHIBITORS.

1. Best Sample of Para Rubber "Biscuits."

Ceylon only.

Gold Medal ; Silver Medal.

Alwis, H. M., St. Michael's road, Polwatta. (3)
Bailey, F. W., Elston, Puwakpitiya.
Biddulph, W. H., Syston, Ukuwella. (2)
Bird, W. J., Duckwari estate, Rangalla.
Booth, R. J., Rogart and Langsland estates, Neboda.
Bowman, E. D., Baddegama estate, Baddegama.
Brodie, R. H. Halgolle estate, Yatiyantota
Cantlay, A. N., Mipitiakanda, Yatiyantota.
Cowley, W. H., Sorana Group, Horana.
Culloden Estate (C. O. Macadam), Neboda.
Dickson, W. G. B., Sarnia Group, Badulla.
Eastern Produce and Estates Co., Ltd., Arapolakanda, Kalutara (H. V. Bagot). (2)
Elson, F. S., Wariagalla, Kandy.
Finlay, Muir & Co., Colombo.
Garnier, R., Ellakanda estate, Horana. (2)
Glennie, A., Gikiyanakanda estate, Neboda.
Hanwella Estate (C. Turton Sinclair), Padukka.
Hayley, Chas. P., Galle.
Heatherley Estate (J. Farley Elford), Neboda. (2)
Holloway, Francis J., Kepitigalla, Matale.
Hunt, C. D., Udagoda estate, Undugoda.
Igalkande Estate, Elpitiya (G. Johnson, Superintendent).
Ingoya Estate (H. E. Walker), Wattawella, Kelani Valley.
James, Gilbert, Katugastota estate, Katugastota. (2)

Mackenzie, R. J., Weoya, Yatiyantota. (3)
Martin, J. R. (Rubber Plantations Co., Ltd.), Hylton, Matale.
Massy, G. G., Clyde estate, Kalutara.
Matthew, A. C., Alliawatte, Monaragala.
Mee, C. C., Anguratotte.
Milne, M. S., Imbulpitiya, Nawalapitiya.
Patterson, J. S., Hapugastenne, Ratnapura.
Pereira, C. A., Colpetty, Colombo.
Pett, Geo. Thornton, Ambatenne estate, Neboda.
Rayigam Estate, Padukka (A. C. Dawson, Superintendent).
Ross Wright, C., Glenesk estate, Avisawella, Kelani Valley. (2)
Somerset Estate, Gampola (F. R. Bisset, Superintendent). (2)
Sylvester, E. C., Glencorse, Puwakpitiya.
The Alliance Tea Co., Ltd., Aberdeen, Watawala.
The Kalutara Co., Ltd. (K. A. Burne, Superintendent), Pallagodda estate, Bentota.
Tisdal, W. N., Vogan estate, Neboda.
Vanderslott, W. L., Dea Ella estate, Galagedara.
Walker, T. R., Forest Hill estate, Kegalla.
Watt, A., Rasagalla, Balangoda.
Webb, E. & H. A., Hindugalla, Peradeniya.
Weerakoon, S. D. S., Kotavila estate, Matara.
William & Bros., J. P., Henaratgoda.

Gold Medal—W. J. Bird, Duckwari estate, Rangalla.

Silver Medal—Gilbert James, Katugastota estate, Katugastota.

Extra Silver Medal—W. J. Bird, Duckwari, for second sample.

Hon. Mention—Eastern Produce and Estates Co., Ltd., Arapolakanda, Kalutara (H. V. Bagot).

Ceylon and Abroad.

GOLD MEDAL; SILVER MEDAL.

Botanic Gardens, Singapore.
Kamuning Estate, Perak, Federated Malay States.
Nicholson, A.G., Hawthorne estate, Shevaroy Hills, South India.
Pataling Estate, Selangor, Federated Malay States.
The Jebong (Perak) Rubber Co., Ltd., Malaya (Agents, Bosanquet & Co.).
The Sione Rubber Co., Ltd., Kuala Lumpur, Selangor, Federated Malay States.
Windle, E. G., Kotagiri, South India.
Yam Seng Estate, Perak.

Gold Medal—W. J. Bird, Duckwari.

Silver Medal—Eastern Produce and Estates Co., Ltd., Arapolakanda estate (H. V. Bagot).

1a. Best Sample of Smoked Para "Biscuits,"

Ceylon only.

Gold Medal—Eastern Produce and Estates Co., Ltd., Arapolakanda, Kalutara (H. V. Bagot).

2. Best Sample of Para Rubber "Sheet."

Ceylon only.

GOLD MEDAL ; SILVER MEDAL.

Alwis, H. M., St. Michael's road, Polwatta.
Biddulph, W. H., Syston, Ukuwella. (2)
Bird, W. J., Duckwari estate, Rangalla.
Booth, R. J., Langsland estate, Neboda.
Colloden Estate (C. O. Macadam), Neboda.
Forsyth, J. G., Kondesalle, Kandy.
Hayden, J. A., Wavena estate, Matale.
Hayley, Chas. P., Galle.
Heatherley Estate (J. Farley Elford), Neboda. (2)
Holloway, Francis J., Kepitigalla, Matale.
Igalkande Estate, Elpitiya (G. Johnson, Superintendent).
Ingoya Estate (H. E. Walker), Wattawella, Kelani Valley.
James, Gilbert, Katugastota estate, Katugastota.
Maclean, D. P., Kehelwatta estate, Lunugalla.
Massy, G. G., Clyde estate, Kalutara.
Milne, M. S., Imbulpitiya, Nawalapitiya.
Northway, C., Deviturai, Elpitiya.
Patterson, J. S., Hapugastenne, Ratnapura.
Pereira, C. A., Colpetty, Colombo.
Rayigam Estate, Padukka (A. C. Dawson, Superintendent).
Southern Ceylon Tea and Rubber Co., Ltd. (C. G. Simmonds, Superintendent), Nattiadeniya, Galle.
Tisdall, W. N., Vogan estate, Neboda.
Vanderslott, W. L., Dea Ella estate, Galagedara.

Gold Medal—W. H. Biddulph, Syston, Ukuwella.
Silver Medal—J. G. Forsyth, Kondesalle, Kandy.
Hon. Mention—Chas. P. Hayley, Galle.
Silver Cup to Superintendent of Syston, Ukuwella.

Ceylon and Abroad.

GOLD MEDAL ; SILVER MEDAL.

Blackwater Estate, Klang, Selangor, Federated Malay States
Botanic Gardens, Singapore.
Dew, W. P. ; Clarke, P. Graham ; and Bayley, C. J., Selin Sing, Perak.
Highlands and Lowlands Estate, Klang, Selangor, Federated Malay States. (4)

Kamuning Estate, Perak, Federated Malay States.
K. Kangsar Gardens, Perak, Federated Malay States.
Pataling Estate, Selangor, Federated Malay States.
Sungei Renjam Estate, Selangor, Federated Malay States.
The Bukit Rajah Rubber Co., Ltd., Klang, Selangor, Federated Malay States.
The Jebong (Perak) Rubber Co., Ltd., Malaya.
The Sione Rubber Co., Ltd., Kuala Lumpur, Selangor, Federated Malay States.
Vallambrosa Rubber Co., Ltd., Klang, Federated Malay States. (2)
Yam Seng Estate, Perak.

Gold Medal—W. H. Biddulph, Syston, Ceylon.
Silver Medal—J. G. Forsyth, Kondesalle, Ceylon.
Extra Silver Medal—K. Kangsar Gardens, Perak, Federated Malay States.
Hon. Mention—Kamuning estate, Perak, Federated Malay States.

3. Best Sample of Para Rubber "Crepe" or "Lace."

Ceylon only.

GOLD MEDAL; SILVER MEDAL.

Culloden Estate (C. O. Macadam), Neboda.
Hayley, Chas. P., Galle.
Heatherley Estate (J. Farley Elford), Neboda.
Holloway, Francis J., Kepitigalla, Matale.

Gold Medal—Culloden Estate (C. O. Macadam), Neboda.
Silver Medal—Heatherley Estate (J. Farley Elford), Neboda.

Ceylon and Abroad.

GOLD MEDAL; SILVER MEDAL.

Botanic Gardens, Singapore.
Highlands and Lowlands Estate, Klang, Selangor, Federated Malay States.
Kenneway, M. J., Kent estate, Kuala Lumpur. (4)
Pataling Estate, Selangor, Federated Malay States.
Pears, F., Lanadron estate, Muar, State of Johore.
Prior, Edmund B., Golden Hope estate, Klang, Selangor, Federated Malay States.
The Bukit Rajah Rubber Co., Ltd., Klang, Selangor, Federated Malay States.
The Jebong (Perak) Rubber Co., Ltd., Malaya (Agents, Bosanquet & Co.).

Vallambrosa Rubber Co., Ltd., Klang, Federated Malay States.
West Country Estate, Selangor, Federated Malay States.

Gold Medal—C. O. Macadam, Culloden, Ceylon.

Silver Medal—Pataling Estate, Selangor, Federated Malay States.

4. Best Sample of Para Rubber "Worm," "Flake Block," or any other form:

Ceylon only.

GOLD MEDAL ; SILVER MEDAL.

Culloden Estate (C. O. Macadam), Neboda.
Eastern Produce and Estates Co., Ltd., Arapolakanda, Kalutara (H. V. Bagot). (4)
Glennie, A., Gikiyanakanda, Neboda. (4)
Holloway, Francis J., Kepitigalla, Matale.
James, Gilbert, Katugastota estate.
Patterson, J. S., Hapugastenne, Ratnapura
Pett, G. Thornton, Ambatenne, Neboda.

Gold Medal—A. Glennie, Gikiyanakanda, Neboda. (4)

Silver Medal—Culloden Estate (C. O. Macadam), Neboda.

Ceylon and Abroad.

GOLD MEDAL ; SILVER MEDAL.

Pears, F., Lanadron estate, Muar, State of Johore.

Gold Medal—F. Pears, Lanadron estate, Muar, State of Johore.

Silver Medal—A. Glennie, Gikiyanakanda, Neboda.

Hon. Mention—C. O. Macadam, Culloden, Neboda.

5. Best Sample of Para Rubber "Scrap."

TWO SILVER MEDALS : (*a*) Washed ; (*b*) Unwashed.

Alwis, H. M., St. Michael's road, Polwatta.
Bailey, F. W., Elston, Puwakpitiya.
Biddulph, W. H., Syston, Ukuwella.
Bird, W. J., Duckwari estate, Rangalla.
Botanic Gardens, Singapore.
Bowman, E. D., Baddegama estate, Baddegama.
Brodie, R. H., Yatiyantota.
Eastern Produce and Estates Co., Ltd., Arapolakanda, Kalutara (H. V. Bagot). (2)
Garnier, R., Ellakanda, Horana.
Glennie, A., Gikiyanakanda, Neboda. (3)
Hanwella Estate (C. Turton Sinclair), Padukka.
Heatherley Estate (J. Farley Elford), Neboda.
Highlands and Lowlands Estate, Selangor, Federated Malay States. (4)

Holloway, Francis J., Kepitigalla, Matale.
Ingoya Estate (H. E. Walker), Wattawella, Kelani Valley.
James, Gilbert, Katugastota estate, Katugastota.
K. Kangsar Gardens, Perak, Federated Malay States.
Kenneway, M. J., Kent estate, Kuala Lumpur. (3).
Massy, G. G., Clyde estate, Kalutara.
Matthew, A. C., Alliawatte, Monaragala.
Northway, C., Devitural, Elpitiya.
Pataling Estate, Selangor, Federated Malay States. (3)
Pett, Geo. Thornton, Ambatenna estate, Neboda.
Sungei Rengam Estate, Selangor, Federated Malay States. (4)
The Bukit Rajah Rubber Co., Ltd., Klang, Selangor. Federated Malay States.
The Jebong (Perak) Rubber Co., Ltd., Malaya (Agents, Bosanquet & Co.). (2)
The Kalutara Co., Ltd., (K. A. Burne, Superintendent), Pallagodda estate, Bentota.
The Sione Rubber Co., Ltd., Kuala Lumpur, Selangor. Federated Malay States. (2)
Tisdall, W. N., Vogan estate, Neboda.
Vallambrosa Rubber Co., Ltd., Klang, Federated Malay States. (3)
Walker, T. R., Forest Hill estate, Kegalla.
Watt, A., Rasagalla, Balangoda. (2)

(*a*) WASHED.

Silver Medal—Vallambrosa Rubber Co. Ltd., Klang. Federated Malay States. (2)

Hon. Mention—The Jebong (Perak) Rubber Co., Ltd., Malaya. (Agents, Bosanquet & Co.) (2)

(*b*) UNWASHED (HAND MADE).

Gold Medal—Heatherley Estate (J. Farley Elford), Neboda.

Silver Medal—Francis J. Holloway, Kepitigalla. Matale.

Hon. Mention—Gilbert James, Katugastota estate. Katugastota.

The Silver Cup (£10) to the Superintendent of the Estate exhibiting the BEST SAMPLE OF PARA to W. J. Bird, Duckwari estate, Rangalla.

6. Best Sample of Castilloa Rubber "Biscuits."

GOLD MEDAL ; SILVER MEDAL.

De Hoedt, F. W., Coodoogalla, Kadugannawa.

No award.

7. Best Sample of Castilloa Rubber "Sheet."

GOLD MEDAL ; SILVER MEDAL.

No Exhibits.

8. Best Sample of Castilloa Rubber of any other form (excluding "Scrap").

GOLD MEDAL ; SILVER MEDAL.

Culloden Estate (C. O. Macadam), Neboda.

Silver Medal and Silver Cup (£10) to the Superintendent of the Estate exhibiting the BEST SAMPLE OF CASTILLOA—Culloden Estate (C. O. Macadam), Neboda.

9. Best Sample of Ceara Rubber "Biscuits."

GOLD MEDAL ; SILVER MEDAL.

Alwis, H. M., St. Michael's road, Polwatta.
Cooper, Cooper, & Johnson, Ltd., Pallekelly estate, Kandy.
Dehigam, L. B., B. N., Peradeniya Junction.
De Lemos, W., Rangbodde estate, Ramboda.
De Silva, M. S., Eastern Produce and Estates Company Stores, Gampola.
Elson, F. S., Wariagalla, Kandy.
Gaddum, G. P., Ambatana estate, Gampola.
Ogilvy, J. H. C., Haloya, Peradeniya.
Pitfield, T. A., Selegama, Matale. (2)
Pyper, Gordon, Hantane, Kandy.
Somerset Estate (F. R. Bisset, Superintendent), Gampola. (2).

Gold Medal—W. De Lemos, Rangbodde estate, Ramboda.
Silver Medal—North Matale Estate.

10. Best Sample of Ceara Rubber "Sheet."

GOLD MEDAL ; SILVER MEDAL.

Cooper, Cooper, & Johnson, Ltd., Pallekelly estate, Kandy.
Dehigama, L. B., B. N., Peradeniya Junction.
Forsyth, J. G., Kondesalle, Kandy.
Westland, Gammadua Group, Gammadua.

Gold Medal—J. G. Forsyth, Kondesalle, Kandy.

11. Best Sample of Ceara Rubber of any other form (excluding "Scrap").

GOLD MEDAL ; SILVER MEDAL.

Dehigama, L. B., B. N., Peradeniya Junction.
Galphela Estate, Wattegama (T. Y. Wright).

No award.

The Silver Cup (£10) to the Superintendent of the Estate exhibiting the BEST SAMPLE OF CEARA to W. De Lemos, Rangbodda, Ramboda.

12. Best Sample of Rambong Rubber.

GOLD MEDAL; SILVER MEDAL.

Highlands and Lowlands Estate, Klang, Selangor, Federated Malay States. (6)
Petaling Estate, Selangor, Federated Malay States.
Prior, E. B., Klang, Selangor, Federated Malay States. (3)
Sungei Rengam Estate, Selangor, Federated Malay States.
The Jebong (Perak) Rubber Co., Ltd., Malaya (Agents, Bosanquet & Co.)
Wyllie, Lt.-Col. J. A., Belgaum, Bombay Presidency.

Gold Medal—Golden Hope Estate, Federated Malay States.

Silver Medal—Sungei Rengam Estate, Selangor, Federated Malay States.

Hon. Mention—Highlands and Lowlands Estate, Klang, Selangor, Federated Malay States.

13. Best Collection of Rubber other than those given above. Ceylon and Abroad.

GOLD MEDAL; SILVER MEDAL.

Highlands and Lowlands Estate, Selangor, Federated Malay States.
Ingoya estate (H. E. Walker), Wattawella, Kelani Valley.

Gold Medal—Eastern Produce and Estates Company, Arapolakanda estate (H. V. Bagot).

Silver Medal—J. Glennie, Gikiyanakanda, Ceylon.

14. Best Commercial Sample of Rubber in the Show (open to all Exhibitors).

GOLD MEDAL; SILVER BOWL (£15 15*s*.).

The latter to be awarded to the Superintendent of the estate.

Bird, W. J., Duckwari estate, Rangalla.
Culloden Estate (C. O. Macadam), Neboda.
Garnier, R., Ellakanda, Horana.
Glennie, A., Gikiyanakanda, Neboda.
Hayden, J. A., Wevena estate, Matale.
Heatherly Estate ((J. Farley Elford), Neboda.
Holloway, Francis J., Kepitigalla, Matale.
Ingoya Estate (H. E. Walker), Wattawella, Kelani Valley.
Kenneway, M. J., Kent estate, Kuala Lumpur.
Krickenbeck, C. M., North Matale, Matale.

Maclean, J. D. P., Kehelwatta estate, Lunugalla.
Mathew, A. C., Alliawatte, Monaragala.
Northway, C., Deviturai, Elpitiya.
Pears, F., Lanadron estate, Muar, State of Johore.
Prior, Edmund B., Klang, Selangor, Federated Malay States.
Southern Ceylon Tea and Rubber Co., Ltd. (C. G. Simmonds, Superintendent), Nattiadeniya, Galle.
Sungei Renjam Estate, Selangor, Federated Malay States.
The Bukit Rajah Rubber Co., Ltd., Klang, Selangor, Federated Malay States.
The Sione Rubber Co., Ltd., Kuala Lumpur, Selangor, Federated Malay States.
Tisdall, W. N., Vogan estate, Neboda.
Vanderslott, W. L., Dea Ella estate, Galagedara.
Vallambrosa Rubber Co., Ltd., Klang, Federated Malay States.

Silver Bowl—(£15 15*s*.) *and Gold Medal*—F. Pears, Lanadron estate, Muar, State of Johore.

Silver Medal—W. J. Bird, Duckwari estate, Rangalla.

Additional Silver Medal—J. G. Forsyth, Kondesalle.

Hon. Mention—Arapolakanda Estate (H. V. Bagot).

The Silver Bowl awarded to the Superintendent of the Estate.

REPORT OF THE JUDGES.

Ceylon.—The exhibits in this division were for most classes numerous and very representative.

Para biscuits were by far the largest class, and the standard of quality and condition was satisfactory. In some cases the samples submitted for examination were superior to the quality of the rubber usually shipped to the London market. It was also noticed that the biscuits with the best tensile strength were those produced from latex from old trees, only a few exceptions being found where this remark did not apply. A decided variation in colour and strength between biscuits in the same exhibit was noticeable.

Some of the samples inspected were composed to a large extent of weak rubber, though the standard of purity was maintained.

The size of the biscuits varied from 3 or 4 inches to about 15 inches in diameter, and in thickness from about 1/32nd to 3/8ths of an inch.

Para sheet.—On the whole, the exhibits in this class were somewhat disappointing, few of the samples showing the same strength as the fine biscuits, although attractive in appearance.

Para crepe.—There were but few exhibits in this class, but those submitted were satisfactory in every respect. The number of entries of fine quality especially was limited.

Para Block, Worm, &c.—Several well-prepared samples of good quality were entered in this class, comparing very favourably with rubber in other classes.

Para scrap (washed) was but poorly represented, the exhibits generally being unattractive. Para scrap (hand made): most of the samples submitted were of good to fine quality, having been carefully prepared and freed from bark and other impurities. The standard of quality was decidedly above that of recent arrivals in London.

Ceara biscuits.—A few of the exhibits in this class were of good strength and quality, but generally the samples were rough and unattractive. The strength of the finest samples was very satisfactory.

Ceara sheet formed a very small class, but the best exhibit calls for special remark, as having been carefully prepared and being exceptionally fine in appearance, quality, and strength.

The entries of *Castilloa rubber* were disappointing both in number and quality, and the standard was not equal to samples recently seen in London.

Smoked rubber.—Several of the exhibits had been treated with smoke, and while being of rather dark appearance, some showed a very satisfactory strength, which points to the advisability of further experimenting with antiseptic processes.

Federated Malay States.—By far the largest class in the Malaya division was sheet rubber, crepe also was well represented, while the exhibits of biscuits were only few in number.

A good deal of the sheet, though being in some cases very attractive in appearance, was somewhat disappointing in strength. Some of the scrap crepe shown was of a good pale colour and satisfactory quality.

Only a few samples of the fine quality crepe had the very pale colour that is much appreciated on the market.

It was noticed that some districts having rubber at the producing stage were not represented.

Rambong.—Several well-prepared samples of Rambong were exhibited in a very marketable form.

Block rubber.—Special interest has centered round the grade of Block Rubber, particularly the samples from Lanadron Estate, which were prepared in a very useful form, and one which has been very well received on the London market. Both from the producers' and users' point of view, fine rubber carefully prepared in this way has many advantages over that prepared by most other methods at present in use.

General remarks.—The Exhibition has shown that rubber with fine strength and resilience can be produced in Ceylon and Malaya from latex from well-matured, healthy trees, by means of careful and cleanly handling and preparation.

Thanks to the scientific and thorough way in which experiments and research work have been carried on by the officials and planters interested, a great deal of information has been secured that cannot fail to be of much value to producers.

It is to be hoped that the knowledge gained by the lessons of the Exhibition will aid planters in bringing the standard strength of this rubber—a point of the greatest importance—to a higher level.

The keen and general interest that has been taken in all details is in itself evidence of the usefulness of the Exhibition to all branches of the industry.

The undersigned wish to express their acknowledgment and thanks for the great courtesy that they received, in the execution of their duties, from all concerned.

SPENCER BRETT.
C. K. SMITHETT.
C. G. DEVITT.

Dated 28th September, 1906.

REPORT BY MR. KELWAY BAMBER.

At the close of the Exhibition it was thought desirable that samples of the prize-winning rubbers of greatest strength, and some of the weakest rubbers, together with rubbers from other countries, should be analysed, so that their composition could be compared and the question determined as to how far the percentages of caoutchouc, resin, &c., coincided with the strength. This point was discussed at one of the meetings with reference to the possibility of a physical or mechanical test being able to indicate the amount of resin or caoutchouc present.

Samples of Para, Ceara, and Castilloa were carefully selected by Mr. S. Brett and myself and analysed in the usual way, the resins being extracted with boiling glacial acetic acid, as this has been found to extract rather more of these constituents than acetone.

The nitrogen has all been calculated as proteid in conformity with old analyses, but it is more than doubtful if all the nitrogen is present in the rubber as such.

A.—Analyses of Rubber Samples exhibited at Peradeniya Exhibition.

Class.	Particulars of Samples.	Prize.	Analyses. Moisture.	Resin.	Ash.	Proteids.	Caoutchouc by difference.
1	Duckwari biscuits	Gold Medal, Cup	0·68	2·32	0·36	3·00	93·64
	Arapolakanda smoked biscuits	Gold Medal	0·28	1·84	0·20	2·12	95·56
	Duckwari, sample No. 2	Silver Medal	0·26	2·28	0·28	1·25	95·93
	Katugastota biscuits	Silver Medal	0·60	1·60	0·50	3·12	94·18
	Do. sample unsmoked	Honourable Mention	0·50	1·64	0·28	2·12	95·46
2	Syston, Para sheet	Gold Medal	0·30	2·74	0·20	2·25	94·51
	Kondesalle, Para sheet	Silver Medal	0·32	1·64	0·20	3·00	94·84
	Kuala Kangsar Garden, Para sheet	Silver Medal	0·32	2·14	0·30	2·25	94·99
	Dolahena, Para sheet	Honourable Mention	0·60	1·88	0·30	2·25	94·97
	Kamuning Estate, Para sheet	Honourable Mention	0·84	2·44	0·44	2·62	93·66
3	Culloden, Para crepe	Gold Medal	0·36	2·04	0·22	2·25	95·13
	Para rubber	Gold Medal	0·42	2·54	0·30	2·62	94·12
	Heatherly, Para crepe	Silver Medal	0·50	2·48	0·26	2·25	94·51
	Petaling crepe	—	0·26	1·70	0·42	2·25	95·37
4	Gikiyanakande, Para worm block	Gold Medal	0·37	2·26	0·26	2·82	94·29
	Culloden, Para block	Silver Medal	0·38	1·18	0·20	2·82	95·42
	Lanadron block, Class Special 7	Gold Medal	0·36	2·44	0·20	3·31	93·69

5	Heatherley, Para scrap unsmoked	Gold Medal	1·30	3·22	0·44	3·00	92·04
	Vallambrosa, washed scrap (Crepe)	Silver Medal	0·24	3·50	0·82	3·31	92·13
	Katugastota, Para scrap	Honourable Mention	1·88	4·84	0·84	7·31	85·13
	Jebong, washed scrap (Crepe)	Honourable Mention	0·26	1·80	0·36	2·25	95·33
8	Culloden, Castilloa block	Silver Medal	3·90	14·56	0·20	1·06	80·28
9	Rangbodde, Ceara	Silver Medal	0·70	3·80	0·80	2·12	92·58
	North Matale, Ceara	Silver Medal	3·10	1·40	1·40	6·13	87·97
10	Kondesalle, Ceara	Gold Medal	1·58	5·74	1·48	5·06	86·14
12	Golden Hope Rambong block	Gold Medal	1·32	5·48	0·52	1·06	91·62
	Highlands Rambong block	Honourable Mention	0·18	6·40	0·28	1·25	91·89
	Nikakotua, Matale Para rubber	—	1·22	3·80	0·40	3·00	91·58
	Para, typical weak sheet	—	0·56	1·56	0·40	2·82	94·66
	Para, typical weak sheet	—	1·04	3·34	0·36	2·82	92·44
	Para, typical weak biscuits	—	0·68	2·14	0·24	3·00	93·94
	Special Prize 6.						
	Hawthorn estate, South India	Gold Medal	0·60	3·02	0·40	2·82	93·16

A careful study of these figures shows how difficult it is to form deductions as to what gives actual strength in the rubber; for the strongest rubbers have not necessarily the most caoutchouc, though the difference of one per cent. in such high numbers as 93 to 95 per cent. would have very slight effect.

By taking the average of Ceylon biscuits and sheet separately and comparing it with Straits sheet, the differences are very slight, there being a little more moisture and resin in the latter.

	Moisture.	Resin.	Ash.	Proteid.	Caoutchouc.
Ceylon Biscuits	0·45	2·01	0.34	2·37	94·83
,, Sheet	0·41	2·09	0.23	2·50	94·77
F.M.S. Sheet	0·58	2·29	0.37	2·44	94·32

Ceylon crepe has a very similar composition, a little being removed by the washing; but the Federated Malay States crepe has less moisture and resin, and rather more ash than the former. In the Ceylon scrap, unwashed, the moisture, resin, ash, and proteid matter are much higher, while the Federated Malay States washed scrap is almost equal to the best biscuits except that the proteid matter is higher.

	Moisture.	Resin.	Ash.	Proteid.	Caoutchouc.
Ceylon Crepe	0·43	2·66	0·24	2·25	94·42
F.M.S. Crepe	0·26	1·70	0·42	2·25	95·37
Ceylon Scrap (unwashed)	1·59	4·03	0·64	5·15	88·59
F.M.S.Scrap (washed)	0·25	2·65	0·59	2·78	93·73

Ceylon worm rubber is almost equal in composition to the best biscuit or sheet, while the Ceylon and Johore Block rubbers are also very similar, the former being lower in resins and proteid, though whether this is an advantage remains to be proved. An analysis of smoked hard Para is given for comparison:—

	Moisture.	Resin.	Ash.	Proteid.	Caoutchouc.
Smoked hard Para	3·88	2·42	0·30	2·97	90·43
Ceylon Block	0·38	1·18	0·20	2·82	95·42
Lanadron Block	0·36	2·44	0·20	3·31	93·69
Ceylon Worm	0·37	2·26	0·26	2·82	94·29

Comparing the three specimens of weak rubber sheet and biscuit in which the resilience was low, it will be seen that

there is rather more moisture in them, otherwise their average composition is very similar to the strong rubbers.

	Moisture.	Resin.	Ash.	Proteid.	Caoutchouc.
Typical Weak Sheets Para	0·76	2·34	0·33	2·88	93·79

The theory that more moisture left in the rubber would add to its strength is apparently not borne out by the above figures, though it is curious that this average analysis is almost identical with that of the Duckwari biscuits, which obtained the gold medal and cup, and it would point to the *method* of preparation and the special reagents used in the latter case being potent factors in the ultimate strength of the rubber.

Ceara rubbers are characterized by a greater proportion of moisture, resin, proteid matter, and ash than Para—in fact a large amount of ash in a clean rubber purporting to be Para could probably be taken as an indication of admixture with Ceara. Castilloa has a still larger proportion of resin, which is characteristic, as it differs entirely in its properties from the oily and sticky resins of Para and Ceara, setting to a hard brittle mass on cooling and melting again below the boiling point of water.

The following table shows the average composition of Para, Ceara, Castilloa, and Rambong rubbers which can be compared with the average analysis of American and African rubbers given below :—

	Moisture.	Resin.	Ash.	Proteid.	Caoutchouc.	Total.
Ceylon and F.M.S.						
Para	·38	2·14	·32	2·61	94·55	100
Ceara	1·79	5·31	1·23	4·44	87·23	100
Castilloa	3·90	14·56	·20	1·06	80·28	100
Rambong	·75	5·94	·40	1·15	91·76	100
American, African, New Guinea.						
Brazilian Para	3·88	2·42	·30	2·97	90·43	100
Indian Ficus	1·03	8·87	·71	1·11	88·28	100
Castilloa	1·54	11·28	·92	2·02	84·24	100
Mozambique	2·42	7·51	1·71	1·66	86·70	100
New Guinea	2·74	4·54	1·30	3·50	87·92	100

Table B shows the composition and value of the individual samples of rubber exhibited by Messrs. Lewis and Peat, London.

B.—Analyses of other Rubber Samples exhibited at the Peradeniya Rubber Exhibition.

Particulars of samples.	Species.	Price per lb.			Analyses.					Remarks.
		£	s.	d.	Moisture.	Resin.	Ash.	Proteids.	Caoutchouc by difference.	
Assam plantation ..	Ficus ..	0	4	3	0·84	12·80	0·60	1·05	84·71	Pink, pure
Darjeeling plantation ..	Ficus ..	0	4	3	1·64	8·12	0·74	0·87	88·63	Red, pure
Assam Red No. 1. ..	Ficus ..	0	3	9½	0·60	5·70	0·80	1·40	91·50*	Pinky, pure; little wood*
Red Penang ..	— ..		—		2·66	5·40	1·80	1·05	89·09	Red and black, sticky
Madagascar ..	— ..	0	3	8	9·44	10·54	0·20	0·70	79·12	Pinky, pure; much moisture
Mangabeira ..	— ..	0	3	1	5·24	6·04	0·80	3·67	84·25	Thick layers, pure, (pinky)
West Indian plantation ..	Castilloa ..	0	4	6	0·32	11·54	1·86	0·87	85·41	Black layers, pure
Mexican plantation ..	Castilloa ..	0	4	6	1·24	18·54	0·20	2·05	77·97	Black, pure
Ecuador roll ..	Castilloa ..	0	3	8	0·84	6·04	0·84	2·22	90·06*	Black sausage strips, some wood*
Ecuador scrap ..	Castilloa ..	0	3	8	1·40	5·34	0·74	2·10	90·42*	Black, woody*
Columbian smoked sheet ..	Castilloa ..	0	3	0	4·60	7·40	1·08	4·20	82·72	Dark, pure
Peruvian tails ..	— ..	0	3	4	0·90	1·84	6·00	1·58	89·68	Black, fairly pure
Java plantation ..	Castilloa ..	0	4	2	0·86	18·86	0·80	0·70	78·78	Pure, black
Mozambique stickless ..	— ..	0	4	5	2·62	7·58	3·08	1·40	85·32*	Pink scrap, some wood sausage*
Mozambique ..	— ..		—		2·22	7·44	0·34	1·92	88·08	Fine red ball
New Guinea ..	— ..	0	3	6	2·74	4·54	1·30	3·50	87·92	Pink and black, pure sausage
Hard cure ..	— ..		—		3·88	2·42	0·30	2·97	90·43*	Pure, little wood*

Here, again, both the American and African Ficus and Castilloa rubbers are characterised by high percentages of resin as in the Ceylon and Federated Malay States samples. Owing to the impossibility of accurately removing all the bark fragments from some of these rubbers, the figures in the last column can only be taken as approximate. Such are marked with an asterisk.

The following remarks by the Deputation from the Planters' Association of the Federated Malay States may also be quoted:—

As will be seen from the list of awards......, Lanadron Estate, by gaining the Gold Medal for the best rubber in the Exhibition, won the blue ribbon of the Exhibition for the Malay Peninsula ; in all other respects, however, the honour of the day undoubtedly rested with Ceylon.

One point, however, in this respect should not be forgotten. All our exhibits were fair-sized commercial samples, quite obviously taken by their respective producers out of actual shipments ; whilst practically all the exhibitors from Ceylon contented themselves with sending in 5 lb. of true "exhibition" samples. One visitor indeed very forcibly put it to me in this way: that whilst the Malayan exhibits reminded him of Mincing Lane, the Ceylon exhibits did of the British Museum.

The Duckwari biscuits come from $1\frac{1}{2}$ acre of 10-year old Para trees grown at an altitude of over 2,500 feet. This latter fact attracted a good deal of attention, and speculation was rife as to whether the altitude had anything to do with the excellence of the product. It might of course be the case that retarding the growth of the tree tends to an increase of caoutchouc in the latex. Personally, however, I am inclined to think that the mode of coagulating, viz., by cream of tartar, affords a better explanation of the strength of these biscuits

Quite the sensation of the Exhibition were the Ceara exhibits, which showed a strength and elasticity superior to even the best Para in the show. Indeed I was told, that if the Kondesalle samples had not been Ceara, they would without a doubt have carried off the Gold Medal for the best rubber exhibited, and the Judges assured me that Ceara up to these samples would fetch in London absolutely top prices, although it is known that Ceara rubber contains twice as much as Para. Indeed, so excellent were the Kondesalle Ceara sheets, that although they formed the only entry for this class, they were without any hesitation awarded a Gold Medal.

The Rangbodde Ceara biscuits come from trees 20 years old grown at an altitude of over 3,000 feet ; whilst the Kondesalle Ceara sheets come from 300 trees, 8 to 20 years old, growing at an altitude of 1,500 feet.

CHAPTER IX.

THE VULCANISATION OF RUBBER.

We come last of all to the subject of vulcanisation. It may be said that this has nothing to do with the rubber planter, and in a way this is true, but the new method introduced by Mr. Bamber may at any time transfer the subsidiary industry of vulcanisation, or rather of sulphurisation, to the tropics. As some people may find the lecture too technical, it may not be out of place here to briefly put before them the essential features of the "Bamber process."

At present the raw rubber is aggregated into lumps, blocks, biscuits, or other forms, and is passed through a machine which tears it to pieces, and then through others which mix with it the sulphur or other agents used for vulcanising, colouring, or otherwise modifying it. A very great amount of power is required for this in order to get the mixture absolutely uniform, and it seemed a great waste to do this to the solid rubber, when it could be more easily and better done to the milk before coagulation. Antimony sulphide, or other vulcanising agents can be absolutely mixed with the latex by a little stirring, and when the acid is added the latex coagulates into a biscuit containing the vulcaniser in absolutely intimate intermixture. This biscuit can then be dealt with exactly like an ordinary biscuit, and worked up into anything required, and when finally heated it vulcanises. In this way, at a trifling cost the whole process of admixture with vulcanisers as at present conducted, is done away with at a considerable saving of expense. In the same way, colouring matters can be easily added to the raw latex, and rubbers produced which have the colour completely intermixed throughout their substance, no mean advantage when making children's toys and such articles. Or, again, the rubber may in this way be mixed with anything that can be wetted, for instance fibre. A useful paving brick can be made by mixing fibre with a very little sulphurised latex, clotting,

drying, pressing in a powerful hydraulic press, and then vulcanising. There is almost no limit to what can be done with rubber by this method, though it will doubtless require much elaboration in detail.

The Vulcanisation of Rubber.

By M. Kelway Bamber.

Ladies and gentlemen: Before describing the vulcanisation of rubber it may be advisable to describe the actual latex. Raw caoutchouc may be defined as the thickened or dried-up latex of certain species of plants. Taking the latex of *Hevea brasiliensis* as typical of most latices, it is, as it leaves the tree, a white-looking milk-like fluid containing variable quantities of minute globular particles, the diameters of which average 3½ micro-millimetres, though the range is great. (One micro-millimetre is the one-thousandth part of a millimetre.) The specific weight of latex containing 32 per cent. of caoutchouc is 1·018 at 60° Fahr. It is these microscopic globules that constitute the real caoutchouc when caused to agglomerate into a mass, either by drying and smoking, the addition of acids or certain other chemicals, or by bacterial decomposition of proteid matter, &c., in the latex with production of a free acid causing coagulation somewhat analogous to the curdling of milk.

The chemical composition of the fresh latex from mature trees and for the first tappings during more or less dry weather is as follows :—

	Per cent.
Caoutchouc	32·00
Nitrogenous matter	2·03
Mineral	9·07
Resinous	2·03
Water faintly alkaline	55·56

I noticed that in the lecture yesterday a question was raised as to the amount of caoutchouc in Brazilian rubber, and I have turned up the old analyses and find Professor Faraday gives it at 37·7 per cent., which is higher than anything we have had here. This is liable to great variation under different climatic conditions, age of tree, soil, and numerous other causes, which it is needless to enumerate here. When latex is coagulated in a vessel by means of acid, the globules do not first rise to the surface like cream and then amalgamate, but coagulation takes place throughout the mass of liquid, the rubber at the moment of formation having the shape of the

containing vessel. As soon as coagulation has set in, the rubber instantly acquires its elastic property, and being specifically lighter than water contracts on itself upwards, at first slowly, but with increasing rapidity, squeezing out from the interior of the mass the bulk of the water and soluble constituents of the latex, until it forms a fairly compact white mass floating on the surface of the clean water. This when washed, pressed, and dried, constitutes rubber and contains 95 to 96 per cent. of pure caoutchouc with a specific gravity of ·92 to ·96.

Raw rubber so prepared has a characteristic odour, but when produced by the fermentation process and imperfectly washed is highly offensive. It is insoluble in water, but its bulk increases by absorption when immersed in that fluid, and it adds 25 per cent. to its weight, while its toughness, adhesiveness, and elasticity are greatly reduced. Raw caoutchouc is very elastic at normal temperatures; but if the temperature is reduced to zero, it becomes hard and brittle, but regains its elastic property on being warmed. If heated to 80° Centigrade or more, it becomes soft and sticky and does not regain its normal properties on being cooled. If exposed for a long time to warm air and light, it becomes less elastic on the surface and more or less sticky or tacky. This condition may also be caused by bacteria or fungi, with probably the production of an oxidising enzyme.

Spiller states that the affected caoutchouc consists of :—

Affected.			Unaltered Caoutchouc.
Carbon	64·0	..	85·5
Hydrogen	8·5	..	12·0
Oxygen	27·5	..	7·5

Heated to 360° Fahr. caoutchouc begins to melt, and between 400 and 440° Fahr. it becomes a dark brown oil. Owing to the above properties of rubber at different temperatures, crude caoutchouc would be of little general use had not the curious reaction of caoutchouc and sulphur known as vulcanisation been discovered.

The only uses for raw rubber are the cubes employed by artists, strips for billiard cushions, and square cut unvulcanised threads. The treatment of rubber with either S or S_2Cl_2 are the only methods at present employed for vulcanisation, though Gerard's process of treating the indiarubber for three hours in a solution of calcium pentasulphide (1·205 sp. gr.) under a pressure of 60 lb. at 140° C. yields very satisfactory results. The chief vulcanisers and sulphur-carriers are sulphur and various metallic sulphides. Sulphur occurs in two

crystalline and one amorphous form. The chiefly-used commercial varieties are sulphur sticks, flowers of sulphur, milk of sulphur, and precipitated sulphur, the latter being undoubtedly the best form of sulphur for vulcanising purposes. It is prepared by the precipitation of sulphur from the solutions of polysulphides with acid, when it separates in an exceedingly fine state of division, and so is capable of more intimate mixture with the indiarubber. Lead thiosulphate ($Pb\ S_2O_3$) and oxide, antimony pentasulphide (Sb_2, S_5) and zinc sulphide are among the chief sulphur-carriers. All the above generally require what is known as hot vulcanisation. Chloride of sulphur (S_2Cl_2) on the other hand is extensively used for the process of vulcanisation in the cold, but at present can only be employed for vulcanising dry goods, as contact with water causes immediate decomposition. Besides the ordinary sulphurising agents, various colouring matters are frequently incorporated, when the rubber is to be used for decorative or ornamental purposes ; but for technical purposes the colour is more or less confined to gray, black, and red. Examples of such colouring ingredients are zinc white, lithopone (zns.Ba SO_4) and green pigments, golden sulphide (Sb_2S^5), vermilion, red and brown iron oxides, and various yellow blues. Rubber may be looked upon as a colloid body, a class which have a high molecular weight and are non-electrolytic. In colloids only one molecule out of many is capable of acting chemically, hence their great chemical indifference. They have the property of gelatinizing or pectising ; but the latter is quite distinct from the former in that it is non-reversible, while the gelatinized state can be reversed by heating or other means. Colloid solutions can be pectised or converted into insoluble colloids at much less concentration than is required for gelatinization ; but the influences that induce pectisation are varied. Some colloidal solutions pectise spontaneously on standing, some by boiling, and many by freezing, while most inorganic colloids pectise on adding to their solutions minute quantities of electrolytes. The question of a change involved in the pectisation of a colloid is still obscure, but it will probably be ultimately proved to be partly physical, but mostly chemical—the changes in the molecules resulting in the fixation of the relative positions of the colloidal molecules. It is possible that the Brownian movement of the rubber particles increased by the change in re-action or the addition of an electrolyte may tend to induce coagulation by increasing the attraction of the various molecules for one another and by their friction produce amalgamation or cementation. Indiarubber is very sensitive to changes of temperature, becoming soft and sticky or tacky at high temperatures, and hard and brittle at low

temperatures, *i.e.*, 10° C. or 50° Fahr. These properties render it quite unsuitable for most economic uses, both in hot and cold countries, and had it not been for Goodyear's and Hancock's discoveries regarding the effect of heating mixtures of rubber and sulphur together to a temperature above the melting point of the latter, the demand for rubber would have been very limited. This process is now commonly known as vulcanisation, and consists in the formation of a continuous series of addition products involving the chemical combination of these two substances—polyprene and sulphur. When heated (under pressure or otherwise) to a temperature of 120° C. or over (the melting point of sulphur being 113·5° C.) the resulting addition compound is a polyprene sulphide of the probable formula (C_{100} H_{160} S) for soft goods and (C_{10} H_{16} S_2) for ebonite, the highest vulcanised product.* The rate at which sulphur enters into combination with the Indiarubber hydrocarbon polyprene (C_{10} H_{16}) varies with each brand of rubber and the temperature and time employed in the vulcanisation, but in most instances there is a steady increase corresponding with the higher temperature and longer period employed, and in the finished product a gradual reduction in elasticity with increase of hardness.

The rubber as imported into England in the various forms now to be seen in the Exhibition first undergoes a process of softening, washing, and mastication to remove solid and other impurities. This is effected by immersing in hot water in wooden vats for twelve to twenty-four hours and then by passing it in small quantities at a time through very powerful rollers revolving at different speeds, which tear and compress the rubber, while a stream of water from above washes away all the impurities in the form of wood, bark, stone, &c. The rollers are made of hardened cast iron and are usually grooved spirally or in the form of lozenges so as to facilitate the shredding and mastication. Their distance apart can be adjusted by tightening screws, and beneath them is a wrought iron collecting tank covered by a perforated plate. The rubber after being passed through several times appears in the forms of a long strip of lacework similar to that so largely manufactured in the Malay States. This process requires much power—a machine capable of working 20 to 30 lbs. of rubber at a time, requiring at least fifteen to twenty H. P. actual. All rubbers vary as to the ease with which they can be washed, but Para is the best in this respect, as it contains fewest impurities. The rubber has now to be dried, which is effected by spreading on iron wires or in stoves capable of being heated to 50° or 60° C.

* Carl Otto Weber, *The Chemistry of Indiarubber.*

(122°–140° Fahr.), care being taken to dry the greasy and pitchy rubbers at as low a temperature as possible. In many cases the sheets soften and fall to the ground in lumps from which the moisture can only be evaporated with great difficulty. The drying room should have a free circulation of air, and the darker it is maintained, the more valuable is the resultant dried rubber. The rubber is then stored until required for industrial purposes.

The loss in weight in washing and drying of raw rubber is very variable, sometimes rising as high as 60 per cent. in inferior kinds, while hard Para loses 10 to 16 per cent. and plantation Para only 1 to 4 per cent. When required for manufacture, the rubber has to undergo a further process of mastication or kneading by frequent passing between massive, hollow, steam-heated rollers over 4 feet long and 19 inches in diameter. One roll is usually smooth, the other grooved, and they revolve at unequal speed, the latter twice as rapidly as the former. The distance apart is capable of regulation, and the rubber is forced through again and again until it becomes perfectly homogeneous in character. Great care is necessary in the process, which, if the rubber is not perfectly dry, takes from 40 to 60 minutes, according to the amount of moisture that has to be evaporated. In most factories rubbers from different sources are masticated separately—some African varieties which become tacky under the action of the hot rolls, taking a much longer time and their sticky character necessitating the addition of a little talc (hydrous silicate of magnesia).

The next process to mastication is incorporation of sulphur or solid sulphides required for vulcanisation, and if necessary the colouring and mineral or other ingredients employed for modifying the rubber according to the uses to which it is to be put. For the operation to be successful the mixing must be perfect, and the mass must form one homogenous whole. The masticated and dried rubber is put through the mixer with 7 to 10 per cent. of sublimed sulphur, though the range is sometimes from $2\frac{3}{4}$ to 25 per cent. In the latter case the excess can only be considered as an inert addition giving a fictitious weight to the manufactured article. 9 to 11 lb. of the rubber are passed repeatedly through the hot rolls, diminishing the space between them as the operation proceeds. As the sheet issues from the roll, it is dusted for the first time with sublimed sulphur and rolled upon itself, and again passed through the mixer. This is repeated until the requisite amount of sulphur, &c., has been added and thoroughly incorporated into a homogeneous mass. In this state, the mass which is still nothing but a simple mixture, is wrought

in the ordinary way for its conversion into threads, sheets, tubes, shoes, or any other object of definite shape. It is only now that vulcanisation is effected.

I would here like to briefly describe the form of vulcanisator. This is a small vertical boiler with a small copper cylinder into which the objects you wish to vulcanise are placed. The water is placed in the cylinder and the whole apparatus is closed and heated until the steam pressure reaches from 3 to 4 atmospheres. With a low proportion of sulphur in the rubber vulcanisation can take place in about half an hour. With a high proportion three to four hours are required. The actual time required for vulcanisation is one of the most important points, and it is very easy to spoil a whole batch of goods by a half or even a quarter of an hour's over-vulcanisation, so that when you have perhaps a ton or more of manufactured articles in these large cylinders being subjected to the vulcanisation process, it requires a large amount of experience to know exactly when the articles are likely to be over-vulcanised, otherwise a little over-heating might spoil them entirely. You have all seen in the exhibition the various kinds of rubber which have to be vulcanised, including large blocks which have to be torn and macerated and mixed with sulphur or other powder, until the mixture becomes perfectly homogeneous; that is to say, that if you cut a section and put it under the microscope the whole section is perfectly uniform.

In the ordinary vulcanisation there is only from 2 to 2·5 per cent. of combined sulphur, but a much larger proportion is usually added in the mixing, and some of this uncombined sulphur frequently appears on the surface of rubber goods in the form of a fine efflorescence. There are three or four methods by which this is accomplished. The first is to introduce the articles into a boiler, and after closing the end hermetically to admit steam from another boiler until the pressure amounts to 52 or 60 lb. per square inch, corresponding to a temperature of 142° C. to 144° C. The length of time that has to be maintained depends on the quality of the rubber, Para vulcanising more slowly than the soft and more sticky varieties; it also depends on the cross-section of the rubber to be vulcanised—thin objects being completed within the first hour and thicker objects requiring two or three hours. The boilers employed for this purpose are frequently of enormous size, the largest being about 65 feet long by 16 feet to 20 feet in diameter. They are constructed of strong wrought iron in a similar manner to an ordinary steam boiler, except that one end is removable for pushing in on a tramway the trays or trollies on which the various articles

are placed. The object of the great length is to vulcanise tubes in a straight line, and so preserve their shape, the tube being mounted on an iron mandrel, the diameter of which corresponds to the inner bore.

Toys and other small objects are vulcanised in moulds, hollow articles usually having a little water or ammonia placed inside them in the mould, so that when heated the elastic force of the vapour compresses the rubber against the walls of the mould. Another method of vulcanising employed for flat objects, such as shoe-soles, belting, sheets, &c., is by the employment of screw or hydraulic presses somewhat similar to a letterpress, the two plates of which are hollow and can be steam-heated from an ordinary boiler. The lower plate is fixed in the screw-presses, but movable in those worked by hydraulic power. Objects made of mixed rubber are placed in moulds between the two plates of the press, which are strongly compressed and steam admitted to a pressure of $2\frac{3}{4}$ to 4 atmospheres, corresponding to a temperature of 128 to 144° C. The length of time required varies according to the proportion of sulphur, the steam-pressure in the plates and the kind of mixture, but rarely exceeds two hours, and this is often reduced to one or even half an hour. In the case of vulcanising by S_2Cl_2, this is dissolved in carbon bisulphide and the objects are immersed in it in the cold.

From the description I have given you can see a large amount of time and power is employed in this process, and what we propose to do out here is to save that time and power by adding sulphur or sulphur compounds to the latex direct from the tree. I have here a sample of latex. I do not know the exact proportion of rubber in this latex, but it is very easy to ascertain the amount. You then would add a measured quantity of sulphur solution of which you know the exact proportion of sulphur, and you will see that it is capable of instantaneously mixing with the latex so that a perfectly intimate mixture is obtainable. This would be done in huge vats, and it would mean that the latex from various estates could be amalgamated and a very uniform product obtained. By a slight stirring you get a perfect admixture. On the addition of the acid to this latex in the usual way the sulphur is thrown out of solution and the rubber coagulated. But as the sulphur is in an extremely fine state of division you will find no sedimentation, and it is thrown out through the whole mass of the latex. The acid, while throwing out the sulphur, causes coagulation of the rubber particles throughout the mass, with the result that the sulphur is thrown out in contact with every molecule of rubber. You can tell the end of the reaction by the ordinary litmus test, which will

turn red on the slightest excess of acid. It is advisable not to add a great excess of acid either in the vulcanisation process or in the ordinary process, as there is no doubt an excess of acid has some effect in rendering the rubber more liable to become soft and tacky. I believe the original idea of coagulation with acetic acid was that the rubber particles rose to the surface, and then set to a solid mass. That is not the case. Rubber sets throughout the whole body of the liquid, and, being lighter than the water, it contracts on itself, and rises to form a layer on the surface. The colouring of latex by organic dye was then demonstrated, and Mr. Bamber went on to say this would be useful for the manufacture of children's toys, as there will be no necessity for poisonous colours being put on the outside as the colour will be mixed throughout the rubber. You will see that this process will mean an enormous saving of time and labour, and I think we shall ultimately obtain stronger rubber, and instead of using 8 to 10 per cent. sulphur only have to add 1 or 2 per cent. I have here some samples of rubber produced in this way, the strength of which compares very favourably with rubber as ordinarily produced. At the time of making this sample, I also made a biscuit from the same latex without any admixture of sulphur or any ingredient. This was dried and treated exactly in the same way as the other biscuit—under the same conditions, and on the same bench—but within a week it ran into a soft tacky condition, whereas in none of these sulphured samples the slightest tackiness was shown. I think this antimony solution, and the sulphur itself, has a very strong antiseptic effect on the rubber. I should like if possible later on to show how vulcanisation actually takes place, but can only do small articles here. Unfortunately the vulcanising press I expected has not yet arrived, and will not be here for another fortnight.

The Discussion.

Dr. WILLIS remarked that the future would be in the possibility, which Mr. Bamber had briefly indicated, of the vulcanisation, colouring, and otherwise treatment of rubber in the shape of latex, instead of allowing it first of all to be coagulated in block or biscuit, whichever it might be, and then breaking it up and practically reconstructing it, as a great many did, into sheet, containing sulphur and other compounds intimately intermixed with it. It appeared to him there must be a loss of strength in the rubber by that method of treatment, and they should first of all sulphurise the latex, and then work it up into any manufactured form

they desired. Whether thereby they would be able to count upon a considerable gain in strength was, of course, a matter for future determination. No one knew much about it at present, but the manufactured article did not appear to be the equal in strength of the raw rubber as it comes from the grower or collector in the jungle; but one had to remember that the manufactured article mainly consisted of adulteration, if he might use the term. It was by that process of adulteration that we are able to get rubber goods comparatively cheaply. One paid very little more for the manufactured rubber than for the raw product. It seemed to him that we should be able to make these additions out here instead of leaving it to the home manufacturers.

A Judge's Views.

Mr. Smithett: There is one thing, I think, that planters should consider in regard to this question of vulcanisation, and that is, that they are flying at the throats of the manufacturers. The rubber output from Ceylon and from the Straits Settlements and the Malay States is a very small thing at present, and it will be some years, even taking Mr. Wright's figures yesterday before it will be equal to or at any rate supplant the wild rubber. The wild rubber comes in the natural state to England, and the manufacturers know how to deal with it, and there is nothing that the manufacturers object to so much as having the article practically prepared for them. We saw this, as the other judges and people present from London will bear me out, in the manufacturers' objection to crepe. They are getting over that objection gradually now, but they objected because it was washed rubber. I think that for a good many years it will be advisable, until Ceylon and the Malay Archipelago can control the rubber market, that you should send as pure an article as possible and not try, if I may say so, experiments in sending the manufactured article or even partially-manufactured article, which would simply annoy and worry the ordinary manufacturer. I think the lecture has been very interesting, and while I think Mr. Bamber has earned our best thanks for it, I should like to give this word of warning.

Mr. Ryan: As a wholesale producer, I coincide with what Mr. Smithett has said. It never pays the wholesale man to go behind the retail trade. That is the one lesson which all Exhibitions have taught us—give every man his little bit of gain. Our business is growing rubber. At the same time there is no harm in our making experiments calculated to improve our manufacture.

Mr. Bamber said he wished it to be clearly understood that he did not think planters would ever be able to go in for this on their estates. What he did think might happen was that some manufacturers from England or America, or possibly Germany, might buy the latex up out here and make their sulphured rubber. He did not think it was a thing the planter would ever try. It was not a thing he could do.

Mr. Zacharias said he was sure they were all very much indebted to Mr. Bamber for his illuminating lecture that day. He quite agreed with Mr. Smithett that until the supplies of rubber produced in Ceylon and the Straits were very much larger than they were at present, the vulcanisation process would hardly be advisable out there. But there was another point to which Mr. Bamber called their attention, and that was the question of tackiness. Tackiness, as they all knew, was their great enemy, and Mr. Bamber had told them that he had reason for believing that it was due to oxidizing enzymes and bacteria and fungi of sorts. He did not know whether that had been found out before, or whether the honour rested with Mr. Bamber of having discovered it, but at any rate it would be one of the most important results that they would take away with them from that exhibition. If tackiness was due to fungus he took it all rubber would be dealt with in some such way as in the Amazon either by asepsis or antiseptics. Mr. Bamber had already told them that great cleanliness would prevent tackiness. Another point was the use of antiseptics, and he would like to know whether it would be possible to prevent tackiness by adding some creosote. A few days ago he had a talk with Dr. Willis, and he was of opinion that it would be quite possible to use creosote. He would be very glad to hear whether it was possible to do that, and whether any experiment that had been made showed that rubber thus treated was inferior or superior to the ordinary article. At the same time they all knew that the rubber as got from Brazil was smoked, and the smoke contained creosote and acetic acid, and this would tend to show that drying wild rubber with a very fine solution of creosote would be the right thing. At the same time Mr. Bamber had told them that morning that acetic acid, if added in any surplus quantity, had just the opposite effect, and he was sure they would all be obliged if Mr. Bamber would further elucidate these few points.

Mr. Bamber said as regards the question of bacteria and fungus in tacky rubber, he worked that out about a year ago. He sterilised sound rubber and inoculated it under very careful conditions with slight traces of tacky rubber. He was by this means able to inoculate a piece of sterilised rubber, and

the tackiness spread rapidly from it. He also got Dr. Castellani to work with him, and he found certain bacteria and one or two varieties of fungus, growing on the inoculated rubber. He also found, as he had said before, there was an oxidising enzyme present in most cases where the tacky rubber was very bad. With regard to the use of antiseptics, he had always pointed out that in his opinion the rubber factory ought to be as perfectly clean and pure as the best dairy. In going through some of the estates one saw tins and buckets—at least he saw them some time ago, for he had not been recently—soiled and with rubber from previous collections coagulated around the sides. He knew from his own experience that the sap in the latex encouraged the growth of bacteria as much as anything they had in Ceylon. With regard to the use of creosote he thought it would be quite possible, and he would be glad to try it by the addition of alcohol or an admixture with some oil which would not affect the rubber. He did not think it was necessary if there was perfect cleanliness in the factory; but one had always to remember in tapping, when new trees were coming in day after day, that in the first tappings they cut through the sap vessels as well as the laticiferous tubes, and thereby got an admixture of sap in the latex with its sugar and other constituents prone to decomposition. He did not think it was absolutely essential to add any creosote or any other antiseptic, though it was not always possible to keep a factory as clean as one would wish. He had seen rubber treated with creosote, and there was no doubt that it was rather tougher, and it possibly had an effect in increasing the toughness. In any case he would be glad to make experiments in that direction.

Mr. Herbert Wright: With regard to the subject of treating the latex with sulphur compounds, I should like to ask one or two questions. I presume it is essential to treat the latex while in a liquid condition with these compounds? Is it possible to carry on such work on an ordinary estate or must the whole of that latex be sent down to some central factory in Colombo or Kandy or wherever the most convenient centre may be. If it is necessary to send down the whole of the latex to a central factory I am rather afraid there may be some difficulty in fixing its real value. From day to day on different trees, on different estates, and on different days, we know that the latex varies considerably. It is not enough to say here are a few gallons of undiluted latex, because the samples even from different trees on different days may possess anything you like from 40 to 90 per cent. of water; so it seems rather difficult if you have a central factory to really arrive at a satisfactory arrangement, but if it could be

carried out on the estates then I think the idea would be more congenial.

Mr. BAMBER, replying to Mr. Wright, said it was quite possible to add solid sulphur compounds to the freshly-coagulated rubber and mix it in the ordinary machines, but he did not think himself there would be any difficulty in ascertaining the correct amount of rubber in the latex. If the rubber was sent down in casks to a central factory it would be well mixed before it reached the factory, and it would be easily possible to accurately weigh the amount of actual rubber in it. They could take out a sample, cure it in a few minutes, compress it between drying sheets, and then weigh the rubber, and they could calculate to a nicety how much there was in the total bulk of latex of actual rubber. It would be quite simple, if they did not wish to wait until the rubber dried, to make out a table with the corresponding weights of wet and dried rubber. As regards specific gravity, it was so very uncertain and the readings were far too uncertain to draw correct deductions from as to the amount of latex in them because it varied so much with the soluble matter in the sap.

Mr. WRIGHT: Then I take it that the planter would not really know the value of the latex he sent until it had been determined at the factory. He could, of course, take counter-readings.

Mr. BAMBER: It would be possible for the planter to do it himself before sending it away.

Mr. WRIGHT: In association with that it might be possible to accumulate latex in large quantities and keep it in a liquid condition by the addition of ammonia. We have been making experiments here with the different latices, and our idea has been to find out how long the latex can be kept in a liquid condition by the addition of formalin or ammonia, and I should rather like to ask Mr. Bamber whether in the event of its being necessary to keep latex in a liquid condition for several weeks it is likely certain chemical changes might not take place. I have samples of rubber prepared from latex kept for six weeks, and I am sorry to say they are inferior, while one might have expected them to be perfect. I am speaking with reference to Para rubber, and Mr. Bamber will perhaps tell us whether any chemical changes do take place.

Mr. BAMBER said that he did not think that when formalin was used there was much chemical change, but in the case of ammonia he thought it was quite possible there would be some change. He had kept latex down in his laboratory for two or three weeks without any deterioration whatever.

Mr. WRIGHT: Two or three weeks!

Mr. Bamber: I think it would have kept 6 or 10 weeks. The only thing he saw was that when worked into biscuits it coagulated a little more rapidly than when it was fresh. The moment the acetic acid was added the whole at once set into a solid mass which was in a way rather a nuisance, as they did not want it to set too quickly. He did not think there was any fear so long as there was no excess of formalin, but merely sufficient to prevent bacteria forming.

Mr. Carruthers said he should like to be allowed to say that among the interesting lectures and conferences there that lecture was one of, if not the most interesting, and he thought there was no doubt they could say almost without exaggeration that that might be an epoch-making paper read to them by Mr. Bamber, and it was possible in the future it might cause great changes in the rubber-producing industry. At the same time he was very glad Mr. Smithett told them quite plainly the position of the men at home, and it was well the matter should be looked at from a practical point of view. The subject might have come better if it had been brought before them by a home manufacturer and not by their friend, Mr. Bamber, but at the same time he was rather glad that Mr. Bamber should have been the man who should have discovered and originated this possibly entirely revolutionary notion with regard to rubber. When the producer in the Federated Malay States began to manufacture crepe, after visiting the manufacturers at home, he had come to the conclusion that they were fighting shy of crepe simply because they were treading on their corns and trespassing on their ground in regard to the manufacture; and he had no doubt directly they began to suspect any rivalry they would have difficulty with them. He thought that with due caution they should keep that matter in the back of their heads at present. That process of Mr. Bamber's would help them in the future, but he thought they ought to "ca' canny" at present. There could be no doubt, as Mr. Bamber's arguments showed, that the proper time to mix any substances with their rubber was when it was in the form of latex. He thought it was an important original idea. They were there hearing a most interesting paper, and he was not sure but that it would be better to treat it at this stage as an interesting paper, and not as something which planters could actually accomplish.

Dr. Cuthbert Christy said he could not talk of the vulcanisation of rubber, as he knew nothing about it, but there was one point with regard to the keeping of latex to which he would like to refer. There was little doubt but that it could be kept for a long time. He had had experience in

London with samples that were over two months old with the addition of a little formalin. They were perfectly good and formed excellent biscuits. The only chemical action that had gone on was the formation of sulphuretted hydrogen. The latex was perfectly good and produced perfectly good rubber although over two months' old.

Mr. RYAN said, in corroboration of what had been said by Dr. Christy and Mr. Bamber, he might mention that for many years from Nigeria and the French Congo they had been in the habit of exporting latex in casks which apparently reach the market, and presumably as it is still going on they find it pays to do so. They had river transport. Some four or five months ago he had exported 2 hogsheads of latex to London, and the commercial report on the resultant rubber was favourable. It arrived in perfect condition. The time in transit was 28 days. There was a delay of 7 days in the London Docks, and before it was actually treated it was about 6 weeks' time from the date it was despatched from Colombo. The remarks made by the manufacturers were to the effect that there was a slight generation of sulphuretted hydrogen. That was the only change made in the rubber.

Mr. BAMBER said there was one other point which he wished to mention. Not very long ago there was a notice in the papers that they were exporting latex from Brazil to France with the view of making the rubber there, and he could not see why we should not be first in the field in this sort of work, although he quite realised it was premature at present. There was not a sufficient supply of rubber to make it worth while the manufacturers coming out here to buy latex, but he thought in the future they would come to this. It seemed to him rather absurd to make your rubber and then unnerve it again by various processes which had been described, mix it with sulphur, which was, as they might imagine, one of the most difficult of processes, and re-form it into sheet. If they could make it on the spot—not themselves, but the manufacturers who could come out and make it—it would be a very decided step in advance and possibly make the demand for rubber greater.

Mr. BRETT: I am quite sure Mr. Bamber's description of vulcanisation must have been extremely interesting to all who have been present and valuable in that way; but I think the difference between that part of the lecture which is merely informing and that part which is to be applied in Ceylon, ought to be emphasized. I understand that Mr. Bamber does not suggest that the actual vulcanisation should take place in Ceylon, but merely the process of combining the latex with sulphur. I mention this because it

struck me that otherwise much opposition might be brought forward, which would be avoided if this were clearly understood. There is one other point I should like to mention. Your Eastern rubber is being very largely used for experimental purposes at present, and every day the methods of preparation are being perfected at home. I have often heard it said that your rubber has a high standard of purity, and possibly in the future it will be possible to use it straightway in the factories for solution purposes, and so on, without any mastication or washing.

Mr. Bamber: I quite agree with Mr. Brett. There is no intention to vulcanise, but the idea is merely to mix sulphur and various compounds out here with the latex or freshly coagulated rubber, and send it home to the manufacturers as sheet; but that would be done, not by the planters, but by the firms of manufacturers coming out, buying the latex and working it themselves.

Mr. Devitt: I should like to ask, if the market is bad, and a planter has two or three thousand gallons of latex on his hands, how is he to store it? He might have to hold it two or three months. Each planter would have a place to store it in. If not he might have to sacrifice at whatever price he could get.

Mr. Ryan: We could fall back on the original method of manufacture.

Mr. Wright said in regard to the maintaining of latex in the liquid condition for a long period there were persons who were afraid to add any chemical agent whatever to the latex, and he wished Mr. Bamber would definitely explain the action of ammonia and formalin. He estimated, though he might be quite wrong, that the addition of ammonia did not prevent decomposition, but it simply neutralised the acids formed in decomposition. On the other hand, he took it formalin acted in a quite different manner and prevented the original decomposition, so that formalin would have preference over ammonia, while it could be driven off easily by the application of heat.

Mr. Bamber said the action of ammonia and formalin was exactly as described by Mr. Wright. The ammonia combined with the acid produced by decomposition by the action of bacteria, whereas formalin prevented the development of bacteria at all, and, therefore, there was no chemical change except possibly the production of sulphuretted hydrogen, which he had not heard of before it was mentioned that day. He did not say no chemical change at all would take place, as slight changes might take place owing to variations of climate and temperature, but they would not be due to the formalin.

This concluded the discussion, and a vote of thanks having been passed to Mr. Bamber for his lecture, those present separated.

Vulcanizing Freshly Coagulated Latex.

Since the publication of the method of vulcanisation, or rather sulphurising the latex or freshly coagulated rubber direct, there have been one or two criticisms of the process, which call for a reply.

To take that of the *India Rubber World* (New York) published on October 1. It is stated that while the experiment is exceedingly interesting, it is not practical, and that Professor Dunstan's estimate of its value is not sound. It states as follows: "That it would be a commercial possibility, however, to take the latex of any rubber tree and make it up into marketable goods is not to be thought of. It should be appreciated that rubber to be of any value to the world at large must ninety-nine times out of a hundred be compounded, and not only compounded, but made up into certain physical shapes for specific purposes. Any one familiar with rubber manufacture can readily see that it would be impossible, for example, to make an elevator belt with the rubber compounded to give the best wearing surface and with a strong friction, by the use of latex in which was a modicum of chloride of sulphur, instead of a doughy compound run into sheets and shaped by the belt press. Indeed, how in the world could any one get any sorts of compounds into latex and chloride of sulphur, and where in the world would reclaimed rubber, and other assistants that are absolutely necessary to-day be added ?"

The statement of Professor Dunstan at the York meeting of the British Association must I think have been incorrectly reported, as it would be a chemical impossibility to vulcanise fresh latex with chloride of sulphur, as decomposition of the chloride would result the moment it came in contact with the water. Its use with other sulphur compounds might however be possible for coagulating the rubber by the acid produced on decomposition ; but the statement that latex of India-rubber can be cured by chloride of sulphur is incorrect.

As mentioned in the discussion after the lecture and demonstration the main object of the invention was not to vulcanise objects out in Ceylon, though there is no reason why ultimately this should not be done, but merely to add the sulphur and *other ingredients* to the latex before (or immediately after) coagulation, and to cause coagulation while the various ingredients were in suspension in the latex - a feat that is perfectly simple, and has frequently been done. I would add that the addition of substances to change the colour, hardness, &c., of rubber forms the subject of a distinct patent to that for adding the sulphur or sulphur compounds alone.

The purity of Ceylon and Malay States Para make it more suitable however for objects that do not require large admixtures of

foreign bodies, so that no difficulty would be experienced under that head; and as regards belting, it is quite as easy to run the freshly coagulated doughy mixed rubber into sheets, as the rubber that has been converted into a doughy mass by repeatedly passing through the powerful machinery employed in rubber manufacturing mills. Why should rubber be coagulated from latex, dried, compressed into blocks, or sent home in any other of the well-known forms, only to be torn to pieces again and converted into a doughy mass with a temporary loss of all the resilience and strength for which it has received enhanced prices, when by carefully adding the necessary sulphur and other compounds to the fresh pure latex from the tree, rubber sheets of perfect uniformity can be produced direct with the maximum strength and elasticity and with a minimum of oxidation?

The Planters of Ceylon or the Straits are not likely to undertake the compounding of various forms of sheet, but what we expect will happen is that a firm or firms of rubber manufacturers will open branches in Ceylon and the Straits and produce the sheets required with their own special secret mixtures by buying the latex direct from the estates, and export such prepared rubber to be made into the necessary objects and vulcanised at home.

Many articles, however, could be made in the rubber-producing countries with advantage; for instance, paving tiles for roads, churches, hospitals, offices, &c., as there are to hand vast quantities of waste products from other industries to form the bulk of such admixtures, and little technical skill would be required for the pressing and vulcanisation of such articles. They could be made of various colours and shapes.

One of the main difficulties I understand in the manufacture of vulcanised rubber is to get perfect uniformity of hardness or resilience throughout the object, and this is owing to the difficulty of insuring perfect admixture of the sulphur throughout the mass.

In the process suggested here, one method is to add one of the many polysulphides saturated with sulphur in solution to the latex, as milk is to tea, and with slight stirring admixture is perfect at once; coagulation is then effected by stirring in the necessary amount of acid, with the result that the sulphur is thrown out of solution throughout the mass in an impalpable form a few moments before coagulation is effected, so that every rubber globule is in immediate contact with several sulphur particles. Other ingredients, very finely ground, can be added at the same time and if necessary kept in suspension by stirring until coagulation is complete.

(*India Rubber Journal, October* 8, 1906.)

It is extremely probable that nearly every rubber manufacturer will laugh at the idea of beginning the manufacture of his rubber goods on a rubber plantation, and until one has given the subject very serious consideration we admit that the suggestion appears ridiculous. At the present time we candidly admit that we are

not yet in a position to state that the idea is more than a suggestion. From the experiments made, however, we are able to say that the results obtained warrant very careful consideration, and offer a very interesting and probably remunerative field for investigation.

Let us see wherein lies any possible advantage in commencing the manufacture of rubber on the plantation.

The following can be taken as the average composition of good plantation Para rubber :—

India-rubber	94·5 per cent.
Nitrogenous matter	1·8 per cent.
Resin	2·7 per cent.
Ash	·2 per cent.
Moisture	·8 per cent.
	100·0

It is clear, therefore, that on the plantation the rubber can be obtained in a sufficiently pure condition to enter into immediate manufacture. . . . . . . The question now arises, Can sulphur and other ingredients be added to this soft wet rubber, the whole thoroughly mixed, then finely sheeted and thoroughly dried, and still enter the same purposes as rubber which has gone to the manufacturer, and been re-washed, re-dried, and mixed by him ? Those who have been conducting the experiments state that excellent results have been obtained by rubber prepared on the plantation in this manner.

If this is so, would the saving compensate for the alteration? On the one hand, you have a material sent over which would cost practically nothing extra and which is ready for the later stages of manufacture. On the other hand, you have a rubber sent over which has to be re-washed, re-dried, then put on the mixing rolls and brought into a state in which the sulphur and other ingredients can be added. It appears that this would effect some considerable saving.

It is natural that in the manufacturer's mind there would at once arise the impossibility of his ever handing over to another person the important part of manufacture known as compounding. We do not suggest that he should ; all we are discussing at present is the possibilities of any change resulting from the new conditions arising from the rational cultivation and collection of rubber. It will be time enough to discuss the commercial aspects of the case when preliminary experiments have shown the advantages of a change of system.

Objection has been taken to this process because it is anticipated that no thorough mixing of the compounding ingredients could be made so long as they are in the wet state. The experimenters have pointed out that no trouble has been caused by this, but it remains to be seen if these views as regards proper mixing are at all similar to what manufacturers have proved to be necessary.

To our mind sufficient evidence has been given to show manufacturers and investigators that a field of research is now opened to them, which promises interesting results. Vulcanization, it must be remembered, is closely connected with the condition of the rubber before heating. Long-continued working between mixing rollers destroys the resiliency of the india-rubber, rendering it more and more plastic. In this state it is known to require more sulphur for vulcanization than rubber which has been treated which has only been worked a short time. It will be of considerable interest to find out if the rubber which has been treated in a condition where no working on mixing rollers at all is required (practically speaking, the rubber being so soft as to render mixing very easy) will exhibit further changes of a similar nature.

So far as the use of the latex itself is concerned we would point out that many attempts have been made to render it directly of service, but hitherto without any commercial success. It is only within the last two or three years that any large amount of latex has been available in any country where its services could be investigated and utilised in a scientific manner. For the benefit of those who apparently do not know of the earlier efforts in this direction we would point out, that in 1825 Hancock took out a patent for the manufacture of ropes where the latex is used for covering the surface of the fibres in order to render them waterproof and more durable. In 1830 Hancock took out another patent in which the principal ingredient is liquid caoutchouc (as he terms the latex) mixed with a fibrous compound made by mixing hair, wool, cotton, or other fibrous substances, "to which should be added certain substances, according to the intended object, such as whiting, ochre, brickdust, emery powder," &c.

In his interesting monograph published in 1857, Hancock states that he gave up any further efforts in connection with the employment of latex direct, owing, first of all, to the difficulties of obtaining it, and secondly, to the fact that when obtained some of the latex had coagulated.

His views he sums up as follows :—

"Although rubber in this state would be very useful, and many things could be done with it which are hardly practicable with the solutions, yet the loss of weight by evaporation being nearly two-thirds of the whole, the expense of vessels and the freight of so much worthless matter will probably prevent its ever being used extensively. Before the difficulty of dissolving ordinary rubber was overcome it was thought that the liquid, if it could be obtained, would be invaluable ; but now, all things considered, the dry material for nearly all the purposes of manufacture is the cheapest and most easily applied, although to persons unacquainted with practical details this may appear enigmatical. I have made very sharp and clean casts with this liquid, and as it is susceptible of tinting with delicate colours, it might for ornamental purposes be rendered very beautiful."

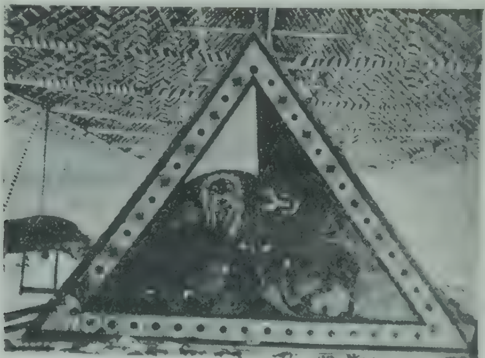
The criticisms in the *India Rubber Journal* of October 8 are more favourable to the possibilities of vulcanising freshly coagulated latex, which is part of our process, than to that of using the latex itself: but the objection to the latter is chiefly based on the fact that the cost of transport to other countries would be excessive owing to the large amount of water contained in it, viz., 66 to 70 per cent. or more. This we quite grant, and it is the chief reason why we suggest that manufacturers should open branches in these countries to save that expense, which would far outweigh the cost of sending out the heavy ingredients of small bulk commonly used in compounding.

It must not be forgotten also that vulcanisation of small thin articles can be done without any admixture of sulphur or sulphur compounds, by merely immersing them for three or four minutes in the cold in a bath of $2\frac{1}{2}$ parts of chloride of sulphur in 100 parts of carbon bisulphide. Rolled out sheets of the freshly coagulated rubber would lend themselves to perfect moulding, and if then dried before immersion in the bath, excellent articles could be made, as the strength and resilience would never have been destroyed.

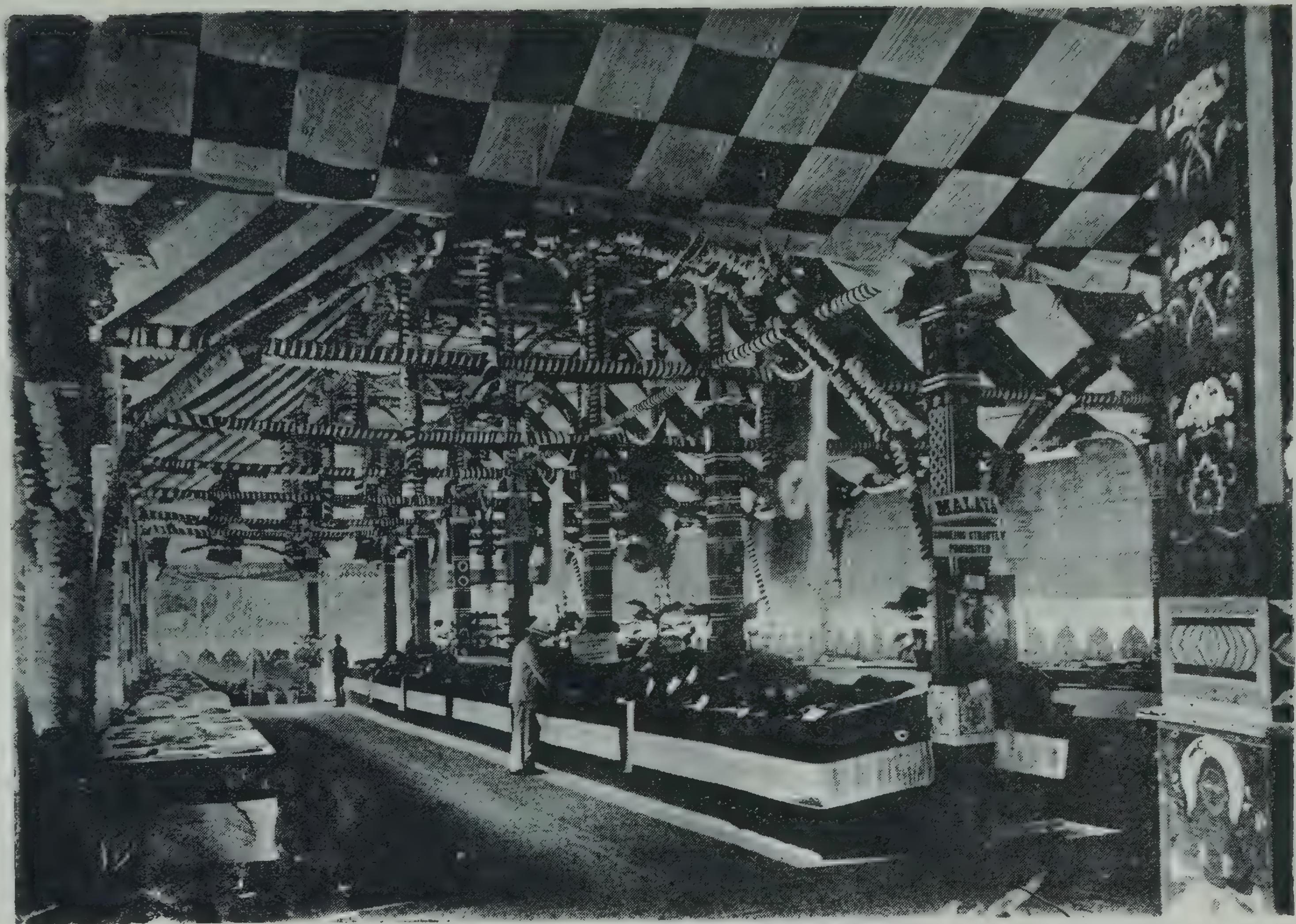
As regards the colouring of the latex, very delicate tints are obtainable and beautifully sharp clean casts can be made by compression of the freshly coagulated latex into moulds, but care has to be taken to select colours that will stand the comparatively high temperature of vulcanisation.

The possibilities of the process are considerable, as the saving of labour and the retention of the elastic properties of the rubber throughout the whole process of manufacture can but yield an improved article, the full value of which has yet to be determined.

It is too early for the process to be adopted at present as the supply of latex is not sufficient, but in a very few years both Ceylon and the Straits, and possibly East Africa, will have a supply of latex that would meet the demands of the largest rubber manufacturers in the world.



A CEILING CLOTH.



Ceylon Biscuits. MALAYAN EXHIBITS. *Block by Survey Dept.*

CHAPTER X.

THE LESSONS OF THE EXHIBITION.

(Lecture by J. C. WILLIS, revised.)

SPEAKING generally, the Exhibition may be said to have been a most unqualified success, and we have learnt many lessons from it, which should indirectly repay its cost many times over. Not only are there these direct lessons, which can be put down in black and white, but the planters of rubber, who attended the exhibition in such numbers, have gained largely by personal contact with one another, by seeing other ways of doing things that they have always been accustomed to do in a particular way, and in other directions.

To deal first with a minor lesson, it is fairly evident that at any future exhibition larger samples must be asked for. No one could fail to be struck with the more imposing and businesslike appearance of the Malayan samples of 28 lb. each than of the Ceylon samples of 5 lb. The latter figure was published by the Committee as a minimum, but everyone took it to be a maximum, and in future the minimum must be fixed higher.

We have learnt that there is in the tropics an almost limitless area available for the planting of rubber—even Para rubber—and that in Ceylon, the tree has proved so much more hardy and resistant than we at one time supposed, that it will grow well enough upon a larger area than was imagined. Not only will the tree grow with irrigation in the dry country—a fact which opens up many scores or even hundreds of square miles to this cultivation—but it will, in sheltered corners at any rate, succeed to a higher elevation than was thought possible; the first prize of the show has gone to rubber grown at 2,500 feet. It is important, however, that people should realise that however good the rubber may be at this elevation—and we have as yet no proof that its superiority was not due

to the greater age of the trees, the method of coagulation, or other causes—it grows so very much more slowly that this defect far more than neutralises any advantage which may be gained by the elevation. We have also seen in the show some very fair rubber—mainly spoiled by bad preparation—grown at Matara in the Southern Province, a district as yet almost untouched by the rubber-growing craze.

We have learnt that almost the whole tropical world is engaging in the cultivation of rubber to a greater or less extent, so that unless new uses come in for this product, as indeed they may be expected to, there must in ten or fifteen years be a very considerable fall in the price, though even a fall to less than half the present price would not destroy the profitableness of the industry. To venture on prophecy is very unsafe, but from the general look of things we should say that within the next two years the price is unlikely to go much below 5*s*.—it is at present 5*s*. 7*d*.—but that after that there will be a comparatively rapid fall till rubber reaches the price at which it will pay to take it up for pavement and other uses to which it is well suited, but for which its present price is too great. The extending use will then check the fall in price, and it will only go on very gradually after that. Fears are sometimes expressed that the production of a substitute will lower the price rapidly, but it must always be remembered that any substitutes so far invented have not the elasticity of true rubber, and so cannot be used for most of its uses, and that any manufacture of synthetic rubber must start from say oil of turpentine, which costs at present about 3*d*. to 4*d*. a pound, but would rapidly rise in price were any use so important to be made of it. What the price may be at which the rapid fall would stop, owing to extension of use, is not for me to say definitely, but I should imagine at about 3*s*.

The rubber planter who has not started on too inflated an estimate can quite well face the chance ot a fall to that price, for the cost of production is at present well below that figure, but it must be remembered that the cost of opening plantations and also of weeding, is turning out in many cases to be greater than was anticipated; and also that the cost of labour will in all probability rise considerably during the next few years.

We have learnt that on the whole wider planting than has hitherto been customary is perhaps advisable—say as an average distance 15 by 15 ft. or 15 by 20, instead of the 10 by 10 which has been so common. The advantage of the latter is the keeping down of weeds, but it is by no means certain, though English planters accept it as an axiom, that this does much good in comparison with the great cost entailed. On

the other hand, it is by no means easy to kill off the extra trees by tapping them to death, and their stumps when they are dead will tend to spread root diseases; while the rubber obtained from the immature trees will be of less value than that obtained from fully grown trees. It would therefore seem advisable to plant at such a distance that the thinning of the trees, which obviously must come in the end, should involve only well-grown and mature trees; the weaklings can be taken out, and the best left.

If the trees are first planted so far apart as 15 feet, there will obviously be room to plant catch crops or green manures between them, and we have learnt that in the dry country cotton and tobacco, in the wet country lemon grass, citronella, and tapioca for temporary, and perhaps cacao or camphor as more permanent crops, may be employed. It is probable that for those who are not obliged to make something while the rubber is growing, the cultivation of green manures, especially the nitrogen-adding Leguminosae, might prove of considerable advantage. The rubber tree is on the whole a surface feeder, and so the manure thus added would easily reach its roots.

With regard to the pests that attack cultivated rubber, we have learnt that every estate should keep a small stock of the chemicals necessary for their treatment, as well as some of the simple apparatus required, such as sprayers. It is much better to do this than to have to look round, perhaps in vain, for such things after an attack of disease has broken out. Belts of jungle or other trees should be left or planted through the rubber, so as to break it up into fields not over about 400 or 500 acres. Jungle stumps, from which root and other diseases are liable to spread to the rubber, should whenever possible be removed.

To turn now to the question of tapping, we have learnt that it should not be performed on very young trees. Hitherto the rubber going from Ceylon has all been sold as "Ceylon rubber," at prices varying only within very narrow limits, but as the quantity on the market increases this will cease to be the case, and the weaker rubber from the young trees will probably sell for a good deal less.

By an omission in the arrangement of the course of lectures, we have not had a discussion of the relative merits of the herring bone, half spiral, full spiral, &c., but opinion in general seems to favour the two first mentioned. The great thing in tapping is to get a good flow with but little waste of bark, for we are now beginning to realise that it takes a long time before the renewed bark is fit to tap, and already several places, which have got very large yields from a free

consumption of their first bark, are finding that they cannot repeat these yields without waiting for a year or two for the renewed bark to become fit to tap.

Tapping knives consequently must shave cleanly, and remove the thinnest possible parings. They must be able to cut either to right or to left, and preferably either up or down. and should cut in straight lines. They should have few or no adjustments, and should be such that they can be readily used by an unskilled man, and be also such that in case of improper use but little damage can be done with them.

While the Para tapping knives shown at the exhibition were comparatively good, no one seems to have devoted any ingenuity to the design of a knife to deal with the entirely different problems presented by the Ceara and Castilloa trees, and there is great opening for invention in regard to these. Especially should some really efficient knife be designed for the Ceara tree, for we have learnt that Ceara rubber gives biscuits and sheet of finer quality even than Para; the samples in the exhibition were valued by the judges at about ½*d.* a pound more than the best samples of the Para rubber. The history of Ceara rubber in Ceylon is interesting and instructive. Introduced at the same time as the Para rubber, by the late Dr. Thwaites, it was largely planted in the early eighties, but the cultivation almost died out again, the return being small, and tea just then coming in and proving to be very remunerative. The yield per tree was small (compared with the yields so far obtained from Para), and the methods of making good rubber had not then been worked out. The tree grows like a weed up to a considerable elevation in Ceylon, and also in drier country than the Para rubber, so that in many ways it is a very desirable cultivation. Lately, stimulated by the enormous returns from Para rubber, many people have been tapping their Ceara trees; but they have in general tried much the same methods as with the former and have tried to get an equal amount of rubber out of them, with the result that the trees have very often died. The knives for tapping Ceara rubber shown in the exhibition bring this point out very well, being all simply Para tapping knives shown in another class. No one seems to have given any thought to the special problems presented by the different quality of bark, different flow of latex, and other characters in which the Ceara rubber tree differs from the Para rubber tree. Were people content to take a smaller amount from their Ceara trees they would probably succeed well enough; the Superintendent of an estate with a large number of these trees told me that he has found from ¼ to ¾ lb. per annum as much as the trees will give during long periods of years and retain their

health. This estate has been exporting this rubber for 20 years.

To turn now to the question of curing, Ceylon biscuits are at present getting very high prices, and many people say that "this is good enough," and do not wish to alter their methods. This is an absolutely wrong principle to go upon. Now is the time to try experiments, before the market has become so firmly wedded to one form of preparation, that it will not hear of change, though that method may be a very inconvenient and expensive one. Proprietary planters at any rate can try experiments, though the salaried superintendent in charge of an estate belonging to a company may not be allowed to. To take a single instance from this very exhibition, look at the results that are likely to follow the manufacture of the blocks from Lanadron. Some people say, and in a sense correctly, that experimenting should be done by the department over which I have the honour to preside; but we have not the men, the trees, nor the money to go in for a large series of experiments, though we shall shortly commence experimenting upon some of the lines of which this lecture gives an indication.

One thing that is very evident is that the biscuits must be given up. Most people who have seen the amateur look of the Ceylon biscuits alongside of the professional air of the Malayan exhibits of sheet, agree about this. My department has preached against biscuits for some years, but in vain, and the opportunity of contrasting them with the sheet was therefore taken at this exhibition, by putting both in the same wing. The biscuit is of course the original form in which Mr. Parkin, who discovered the method of making good rubber, made his samples in the laboratory, and it is quite unsuited to commercial use, when latex has to be coagulated by the ton.

Whether sheet or block is to be the form to replace the biscuit is a matter for further consideration. In the long run, perhaps, we shall be able to prepare large sheets out here, which shall be capable of being used for most or all of the purposes for which rubber is employed, but for a long while yet this will be impossible, and for the present it would seem as if the general arguments were in favour of block rather than sheet or biscuit. Not only do the two latter offer a very large surface to oxidation and to evaporation, but they also occupy so much more space, and take so much more trouble to pack than the large blocks, that they will cost a good deal more in packing and freight. The bulk of the blocks shown by the Lanadron estate was very small in comparison to their weight, and certainly not over half of that of an equal weight

of biscuits. In addition to this, there seemed to be a certain amount of evidence that the rubber in the block was actually more springy than that in the biscuit, and as we shall presently see, this is a point of very great importance. Not only so, but the block rubber has lately been selling in London at about 2*d*. a pound better than the biscuit or sheet, though it is true that we are told by the brokers who have visited the Exhibition that this would not be likely to continue if it came upon the market in large quantities.

These Lanadron blocks must by no means be looked upon as the last word in block-making, but simply as an indication of directions in which to experiment. For one thing they are, it seems to me, too thick, and would have to be cut into three before they could be passed through any of the machinery in use in a rubber factory. It would seem as if blocks only 2 inches thick, instead of 6 inches, would be better suited to the general conditions.

In regard to preparation we have obtained indications of many directions in which research is desirable. Thus, to begin with, we have seen that so far as the rubber shown here is concerned, the Ceylon rubber is in general a shade stronger and better than that from the Malay Peninsula (leaving the block rubber out of consideration). Now the only difference in the preparation is that perhaps the latter is more washed than that of Ceylon, and are we to conclude from this that washing too much is not advantageous, or is it simply that the Ceylon rubbers, being smaller samples, were more excellently prepared than usual.

We have learnt, if indeed we did not know it already (for it was pointed out by Mr. Parkin in 1899) that the rubber from old trees is better and stronger than that from young ones. At the present time, when the prices of rubber are very high and everything placed on the London market sells readily as "Ceylon rubber," the presence of much immature rubber is not noticed, but there is very little doubt that as our rubber increases in quantity, this will alter, and rubbers will be sold on some more careful system of testing or analysis, and that then the immature rubbers will sell for less. The general lesson to be learnt is to tap only mature trees—no tree should in any case be tapped, Mr. Proudlock has told us, before it has flowered, and I would add to that, before it has flowered freely.

We have learnt that smoked rubber—even when it is only the milk that has been smoked, before coagulation—is in general stronger than the unsmoked. Now why is it? Is it simply that the rubber is thus made antiseptic, for in this case probably the method which was used by Mr. Parkin in making the first rubber biscuits, of adding a little creosote

to the milk, would be less trouble, or is it that the smoking, as such, actually improves the quality? These are points to be carefully studied, and the reasons elucidated.

Then again, is the actual chemical used in coagulation of any particular importance? The first prize went to the Dukwari biscuits, which, it happens, were coagulated with cream of tartar and rubber whey (by the way, I may mention that the use of the whey is not uncommon, though not yet perhaps generally known). Now it is possible that their quality may be due to the method of treatment, especially as they were no less than three years old. Parkin showed that many acids could be used in coagulation; he mentions acetic, sulphuric, hydro-chloric, nitric, oxalic, tartaric, and citric, but he recommends acetic, as the range for successful coagulation is much greater with it than with the others.

Lastly, we come to the most noteworthy feature of all, the differences between Para rubber from the Amazon and Para rubber from the eastern plantations. It is very hard to convince people out here that the latter is really getting a lower price than the former, yet as the former contains 20 per cent. of moisture, it is obvious that it will require 10 lb. of it to give as much rubber as 8 lb. of Ceylon rubber, or in other words, equal quantities of the two rubbers are to-day selling at 610*d.* for wild, against 536*d.* for plantation, a very considerable difference, and one which should as soon as possible be put the other way.

Now why this difference? A very slight examination of the large blocks of wild rubber that are here to-day will show the reason for it. The wild rubber is much springier; when drawn out to a considerable extent, it springs back with a snap at once to its original form, whereas none of the plantation rubber, whether of Ceylon, Malaya, or Mexico, does this, but springs nearly back, and then contracts slowly over the remaining difference. When we examine the two rubbers we see at once that the main points of difference are that the wild rubber is in blocks, is very damp, and smells of creosote, and there may be other differences that we do not recognise.

Now it would appear, from superficial examination, that the block rubber from Lanadron is actually more springy than the biscuit or the sheet, and we have seen that smoking—and probably creosoting—seems to strengthen the rubber. The only point remaining is therefore whether its dampness is really an advantage, and my department will shortly proceed to test this as well as possible. Mr. Bamber has already arranged with one of the chief estates in Ceylon to be allowed to make block out of damp biscuit, and we shall place this upon the London market. It is probable that buyers will

look somewhat askance at this very novel form of plantation rubber, but if it even sells for 5*s.* 2*d.* at the present market rates, we shall be getting a better price than the wild rubber, while if it sells for 4*s.* 6*d.* we shall beat the plantation rubber selling at 5*s.* 7*d.*

There is little doubt that the use of antiseptics, such as creosote or formalin, is a practice that has much to recommend it. Mr. Parkin, in working out the original method of making biscuits, recommended the regular use of creosote in the coagulation, and we have seen that the South American rubber reeks of creosote. There will be much less risk of tackiness, for instance, in these circumstances, or of heating of the packed rubber, both of them, as we have learnt only too well, things that are by no means unknown in our rubber in London. Another point we have seen in this very Exhibition, emphasising the same thing, is the fact that Mr. Bamber's sulphurised biscuits were actually stronger than the unsulphurised.

Whether, on the other hand, the long-continued use of antiseptics, as for instance to preserve the latex for weeks, is advisable, is a matter open to considerable doubt. We have had several indications during the exhibition that this long keeping does not improve the quality of the rubber ultimately made from the latex.

To come now to packing, we have learnt that probably the most suitable package at present is something of the nature of a tea box, to hold say 100 lb. of rubber. Considering the shrinkage that rubber undergoes, it is worth consideration whether a rather narrow box, more like a short coffin, to carry say 50 lb. in blocks, might not be advisable.

Lastly we have had a lecture on the subject of vulcanisation, and have seen for ourselves the very pretty and interesting samples of vulcanised and coloured rubbers which Mr. Bamber has made by his new process. Though much opposition is to be expected at first, it would almost seem as if this were the method of the future, and it opens up the possibility of many new and important uses for rubber.

There are doubtless many other lessons which could be pointed out by others, but these are those which have most struck myself, and I must be content to have pointed them out, and in so doing to have to some extent indicated the lines upon which my department will work with rubber in the immediate future.

VIEW OF THE INTERIOR OF THE ARTS AND CRAFTS EXHIBITION.

CHAPTER XI.

WORK OF THE CEYLON AGRICULTURAL SOCIETY IN CONNECTION WITH THE RUBBER EXHIBITION.

I.—Exhibition of Arts and Crafts.

IT may be generally true that "good wine needs no bush." But the arts and crafts of the Ceylon villager are a mellow vintage, yet for lack of advertisement find but little appreciation amongst the general public of the Island. At the present time the sole institution which aims at affording the village craftsman the opportunity of putting his wares before the public is the Museum of the moribund Kandy Art Association—"moribund" inasmuch as the "association" nowadays consists of the Government Agent of the Central Province and his Office Assistant, and is financed by an annual grant from Government. Under the supervision as Secretary of an officer whose artistic sympathies are keen enough to make him welcome this addition to the routine of his duties in the Kachcheri, the Association can do much to preserve and foster the crafts that still exist in various villages of the Kandy District. But for customers it is in the main dependent on residents in Kandy and on the occasional passenger, for the privilege of whose patronage it is beholden to the good offices of the Municipal guide. Nor do its operations cover the whole of the hill-country, much less the Tamil districts of the North and East or the Sinhalese low-country. As regards the last-named, occasional facilities for advertisement have been provided at the agri-horticultural shows held from time to time in Colombo

and elsewhere, and the lace-workers of Boralesgamuwa, the basket-weavers of Kalutara, or the brass-workers of Negombo have facilities for putting their wares on the Colombo market, of which they have not been slow to take advantage. But the dyers and weavers of the North reck little of the uses of advertisement, while in this twentieth century there are enlightened persons in Colombo who will scarce believe that any good thing can come out of benighted Batticaloa.

The first attempt to get together an exhibition of arts and crafts representative of the whole Island was that made under the auspices of the Ceylon Agricultural Society in connection with the Rubber Exhibition last September. The suggestion that such an exhibition should be arranged was brought by His Excellency the Governor before the Board of Agriculture at its meeting held on the 6th August, when a resolution was passed to the effect that an exhibit representative of native arts and crafts should be shown under the auspices of the Agricultural Society at the forthcoming Rubber Exhibition. In pursuance of this resolution a circular was addressed to the Government Agents and Assistant Government Agents of the various provinces and to the secretaries of the different local branches of the Society soliciting their aid and co-operation. At the same time Dr. A. K. Coomaraswamy kindly undertook to supervise the arrangements, with a view to obtaining a collection representative of the best work of the native craftsmen, both old and new, and more especially to securing the services of the best artificers in the various branches to give practical demonstrations of their methods on the spot.

Some of the officers addressed regretted that the notice given them was too short to admit of their securing satisfactory exhibits, for owing to the lack of a regular market many of the best craftsmen work only to order and keep no stock of their wares in hand. But despite this difficulty Dr. Coomaraswamy was enabled, through the ready co-operation of many of the local societies and Government Agents, and through his personal knowledge of a number of the best workmen, to get together an exhibition which not inadequately represented the majority of the native arts and crafts; and it is not too much to say that this "side show" proved to many visitors one of the chief attractions of the Exhibition, as was proved by the numbers that daily crowded the Arts and Crafts Pavilion.

Particulars of the exhibits shown and the parties at work are given in the lists attached. Further reference to them will be found in Dr. Coomaraswamy's report and in his handbook specially prepared for the Exhibition. The Exhibition of Arts and Crafts was in the main a loan

exhibition, though it was open to any of the exhibitors to avail themselves of the opportunity for the sale of their exhibits. One of the principal exhibitors was Dr. Coomaraswamy himself, who was good enough to lend a number of valuable specimens of Sinhalese embroidery, &c., from his private collection. Mr. T. B. Keppitipola exhibited some interesting family heirlooms, and it is probable that several of the Kandyan Chiefs would have been willing to exhibit similar samples of the best antique workmanship had not the Exhibition Committee been unwilling to incur the responsibility of securing their safety in a building of so temporary a nature as was the Pavilion of Arts and Crafts. For the same reason the Committee was reluctantly compelled to refuse the offer of the loan of a quantity of valuable jewellery from the Northern Province. It is to be regretted that owing to the lack of any kind of a strong room on the Exhibition grounds it was found impossible to adequately represent the art of the native jewellers, either Sinhalese or Tamil.

The exhibition of arts and crafts being non-competitive, no prizes were offered to exhibitors. But they were allowed the privilege granted to exhibitors of rubber, of the free transport of their exhibits, and in the case of members of working parties a free fare on the railway. Certificates designed for the Agricultural Society by Dr. Coomaraswamy were granted to exhibitors and to the working parties, and were distributed to the recipients by Her Excellency Lady Blake on the afternoon of the 21st September.

On the principle that "well begun is half done" the Agricultural Society may be permitted to congratulate itself on the success that has attended its first effort towards the encouragement of native industries other than those purely agricultural. The exhibition of Arts and Crafts was the means of directing the attention of numerous visitors to hitherto unsuspected sources of useful and ornamental workmanship; while to those who had already some knowledge of the subject was afforded the opportunity of studying at first hand branches of industry which had not previously come under their notice. This is not the place to discuss how far the Agricultural Society should endeavour to make the encouragement of the industrial arts a permanent feature of its activities, nor to what extent it is desirable that Art Associations should be formed in various centres with a similar object. But whatever action may be taken by the parent society there is every reason why the committees of the agricultural shows that bid fair to become an annual function in many of the principal towns of the Island should seriously consider the advisability of following the example set them at the Rubber Exhibition. There is probably

no district of Ceylon where there may not be found exponents of some of the ancient crafts —crafts that are no less worthy of being rescued from oblivion than are the ancient language and literature of the people. A problem that usually presents itself to a show committee is the difficulty of arranging attractive "side shows" which shall secure the interest of those not agriculturally minded and relieve for the fair visitor the tedium of an endless array of snake gourds, bitter gourds, and bottle gourds, of "goraka" and "murunga" and "kon." Since the opening of the Rubber Exhibition this problem has already been solved by one such* committee in the way here suggested. An open booth was erected inside the main enclosure of the show, in which were accommodated parties of weavers and ivory workers from the neighbouring districts, while in the town hall not far away was arranged an admirable collection of jewellery and art work of all descriptions, both ancient and modern. The erection of the necessary sheds for working parties at agricultural shows would cost the committees little extra expenditure, while the craftsmen would not be slow to appreciate the advantage to themselves of availing themselves of such an opportunity for giving a public demonstration of their skill. In most of the towns where shows are held is to be found a town hall or public library, which can be utilised to house a loan collection of works of art, and a Kachcheri vault where, if necessary, the more valuable articles can be lodged at night. Few people are averse to airing their family jewels for the benefit of the public, provided their safety is guaranteed.

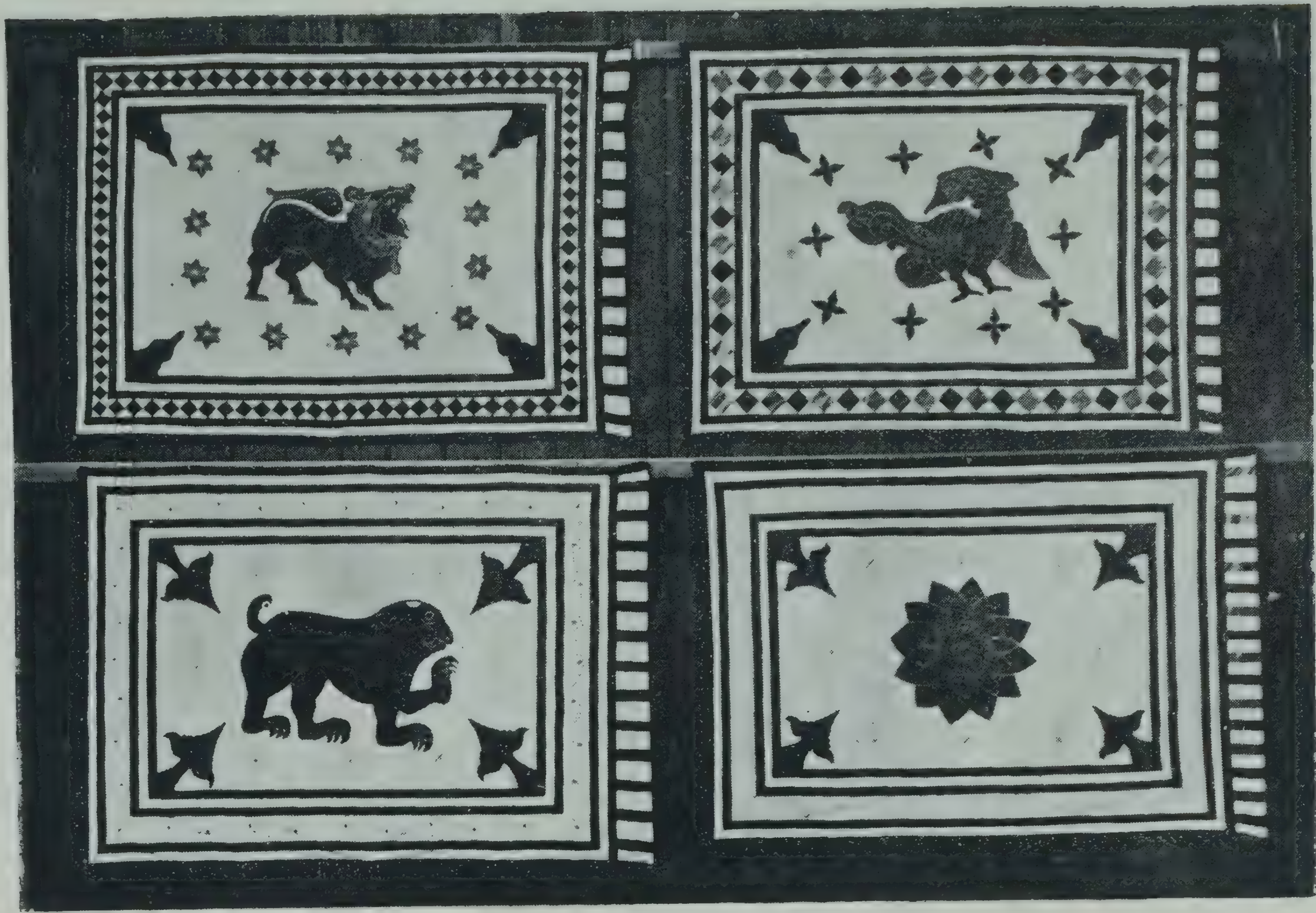
It is recorded in "Ireland, Agricultural and Industrial"† that in 1746 the Royal Dublin Society resolved that "since a good spirit shows itself for drawing and designing, which is the groundwork of Painting, and so useful in manufactures, it is intended to erect a little academy or school for drawing and painting, from whence some geniuses may arise to the benefit and honour of this kingdom, and it is hoped that gentlemen of taste will encourage and support so useful a design." Visitors to the Ceylon Rubber Exhibition of 1906 can have no doubt that a similar "good spirit" is to be found amongst the village craftsmen of Ceylon, and if it be premature to anticipate the immediate erection of "a little academy or school" wherein coming generations may be encouraged to uphold the traditions of their forefathers and to adapt to modern requirements the principles of indigenous

* Kegalla.

† Published by the Department of Agriculture and Technical Instruction for Ireland, 1902.

FLAG OF THREE KORALES. *Block by Survey Dept.*

FLAG OF KURUNEGALA. FLAG OF UVA.



FLAG OF TAMANKADUWA. FLAG OF UDAPALATA.

Block by Survey Dept.

FLAG OF WELLASSA.

FLAG OF NUWARAKALAWIYA.

Block by Survey Dept.

art, eschewing the gewgaws of Germany, it is to be hoped that "gentlemen of taste" will not be found wanting to encourage by every means in their power the successors of the painters of Degaldoruwa and of those artificers whose handiwork is treasured in the Daladá Máligáwa.

II.—Special Exhibits of Agricultural Produce, &c.

Apart from the Pavilion of Arts and Crafts one half of the north wing of the main pavilion of the Exhibition was placed at the disposal of the Agricultural Society. Here were displayed sample exhibits of a variety of the chief products of the Island. Of these, the most important were coconut products, cocoa and chocolate, cinnamon, cotton, tobacco, camphor, paddy, and dry grains. Tea was not represented. It would have been unseemly that the old love should witness the triumph of the new.

By special request of the Society Mr. Kelway Bamber kindly undertook to arrange exhibits of *coconut products*, *tobacco*, and *camphor*, and in connection with the latter gave a demonstration of the method of distillation with a still specially erected in the machinery section, besides showing samples of prepared camphor and camphor oil. Tobacco was represented by an exhibit of cured leaves from Jaffna and Dumbara, two of the principal tobacco-growing districts of the Island, and by a collection of locally manufactured cigars contributed by the Dumbara Agricultural Society. A Dumbara cigar of unusual dimension created a mild sensation in the lecture room. Its mildness is a pleasing feature of the Dumbara cigar.

Mr. Bamber's exhibit included an interesting series of samples of tobacco soils from Java, Sumatra, and Ceylon, the last-named including specimens from Jaffna and Maha Iluppalama.

Samples of Sea Island and Egyptian *cotton* were supplied by Dr. H. M. Fernando and of the Caravonica variety by Mr. J. W. C. de Soysa, while in the machinery section Mr. J. Whitehead presided over the ginning machine and the dyeing tub.

In the east wing of the main pavilion, away from the rest of the Society's exhibits, Mr. E. E. Green, Government Entomologist, showed a very complete exhibit of the rearing of *silkworms*, the worms and moths of the Peradeniya Silk Farm pursuing their avocations in public regardless of criticism. An interesting item of this exhibit was a piece of silk cloth, spun and woven locally from locally grown silk, and said to compare favourably in quality with the produce of Assam.

A collection of native *dyeing* and *tanning* stuffs was arranged by Mr. C. Drieberg, Superintendent of School Gardens, while samples of oil-bearing seeds, gums, resins, dyes, tanning

stuffs, and fibres were sent in by several of the local branches of the Society.

Mr. Bamber's collections of *paddies*—both hill paddies and those grown on mud lands—and *dry grains* well represented some of the staple foods of a large proportion of the inhabitants of Ceylon, though neither collection was by any means an exhaustive one. Mr. Bamber also showed specimens of a new form of manure for use in paddy cultivation. The novelty of the method consists in the fact that coarse coral and bones are saturated with sulphate of ammonia, sulphate of potash, &c. The coral or bones, being scattered with the paddy seed, sink into the mud, and the soil thus reaps the full benefit of the added chemicals. It is believed that such a manure will have considerable advantages over the ordinary crushed bone.

A tastefully arranged exhibit was that of *cocoa* and *chocolate* shown by Mr. C. C. Barber of Matale. This was of especial interest as indicating that when Ceylon chooses to become her own manufacturer there is no reason why she should not prove as successful in the preparation of the finished article as in the production of the raw material. Mr. Barber showed cocoa in all stages of its manufacture, from the pod to the breakfast cup, while his gaily bewrappered slabs of chocolate would have done credit to Messrs. Cadbury.

An exhibit of cocoa pods from the Government Experiment Station at Gangoruwa showed the different characteristics of the Caracas, the Forastero, and the Amelonado varieties. From the same source came an exhibit of *citronella* and *lemon grass* and the oils extracted from them.

Of the spices *cinnamon* was the most prominent, being represented by a large show case sent by Mr. A. E. Rajapakse, Muhandiram, from the Negombo district. The case contained a graded assortment of cinnamon quills, together with chips and samples of the oil.

Of the other spices *cardamoms* and *vanilla* were exhibited under the heading of *catch crops* to be grown with rubber. Properly speaking these exhibits of catch crops belonged to the rubber section of the Exhibition, but it was found more convenient to arrange them with the exhibits of the Agricultural Society. No prize was offered under this head and it was not long before the opening of the Exhibition that it was intimated that samples of catch crops would be accepted. Had longer notice been given it is probable that they would have made a better display than they did. Other samples of catch crops shown were *castor*, *groundnuts*, *manioca* (*cassava*) *cotton*, and *ayapane tea*.

For such success as may have attended its display of special products the thanks of the Society are due to those gentlemen

who so readily responded to the invitation to send in sample exhibits. Excepting tea the collection was fairly representative of the principal products of the Island, old and new; and if the charms of camphor, cotton, and tobacco were for the time overshadowed by the proximity of rubber, their exhibition served at least to remind those who threaten synthesis and would warn the rubber planter not to prematurely count his chickens that were ever their forebodings fulfilled there still are other eggs in the basket.

III.—Meeting of the Board of Agriculture.

The usual monthly meeting of the Board of Agriculture was held on the 17th September in the Pavilion of His Excellency the Governor on the Exhibition grounds. His Excellency presided, and about twenty members of the Board were present, as well as a number of visitors.

A paper on "The Use and Objects of Agricultural Societies" was read by Mr. E. B. Denham, C.C.S., late Secretary of the Board. Beyond the reading of the reports of the Judges at two Agri-Horticultural Shows and other formal business, the chief other item of interest on the agenda was the consideration of a memorandum drafted by Sir William Twynam, K.C.M.G., on the subject of the proposed Ordinance dealing with the prevention and mitigation of agricultural pests. It was agreed that the memorandum be referred to a committee, the members of which have recently submitted their recommendations to the Board.

IV.—List of Exhibits.

(1) *Exhibits by Branch Societies.*

Batticaloa: Specimens of cloth woven locally; Brass work.

Chilaw: Specimens of locally-made towels, napkins, and table cloths.

Dumbara: Suit, &c., made of *Riti* bark cloth, dyeing barks and nuts, oil nuts and oils, tobacco, cigars.

Jaffna: Pottery, walking-sticks, model palmyrah tree, palm climber and his implements, images, ola baskets, model domestic implements, cloths woven and dyed, cotton twist, ola head gear, fishing ropes of cotton and *wara* fibre, fishing nets, ichchan ropes, palmyrah products, mats, ola toys, ola arecanut pouch, ola book, &c.

Kalutara: Native dyes—pandu, prepared from jak root and domba leaves; sapan (patangi); mangrove (kadol); mats, baskets.

Kandaboda pattu : Dyed reed bamboo baskets.

Katunayaka : Cinnamon (exhibited by the Chairman, L.A.S.) Coconut products.

Mannar : Native dyes—chaya root ; local cloths.

Matara : Pottery, baskets (14 pieces), grass mats, wood carving, painting, embroidery, lace work, medicinal oil, forest produce.

Telijjawila : Knives, sword, carved wooden box with specimen horoscope, rattan work consisting of gemmers, baskets and articles in domestic use, rattan boxes, brass-ware, carved ebony betel box, ivory model of the interior of the Dalada Maligawa, presented in 1755 by King Kirti Sri Raja Sinha to Wewa Inda Sara Terunnanse of Hittetia Temple.

Trincomalee : Fan made of paddy seeds ; paddy plates of different patterns.

Vavuniya : Basket-ware, native dyes, and forest produce.

Wellaboda pattu (Galle) : Lace work, native dyes, brass lamps, spittoon, pots, dish, box, betel stand, spoons, and grass mats.

The Ceylon Agricultural Society (per Mr. M. Kelway Bamber) : Paddies, tobacco, dyeing and tanning barks, oils and oil-nuts, fibres (collection from local branches).

(2) *Exhibits by Individual Exhibitors.*

Abaran Appu, M. P. M. : Silver bowl and bronze "tappa kendia."

Appu, M. : Copper plate.

Appu, A. M. : Brassware, &c.

Appu, Motgamuwe Dingiri : Door handles inlaid with silver and copper.

Appuhamy, D. : Old brass spear head.

Arumokam, B. : Old brass bullet mould, brass drinking vessel from Batticaloa.

Bandaranaike, Don S. Dias, C.M.G., Maha Mudaliyar : Utensils, &c., made of cocoanut wood and shells.

Bastian Sinno, B. W. : Two sets baskets, native dyes.

Beven, A. W. (Horrekelle, Marawila): Coconut products.

Ceylon Social Reform Society : Copies of old Sinhalese work.

Clarence Memorial School : Sinhalese embroidery.

Coomaraswamy, Dr. A. K. : Old Sinhalese woven cotton cloths ; old Sinhalese embroidery.

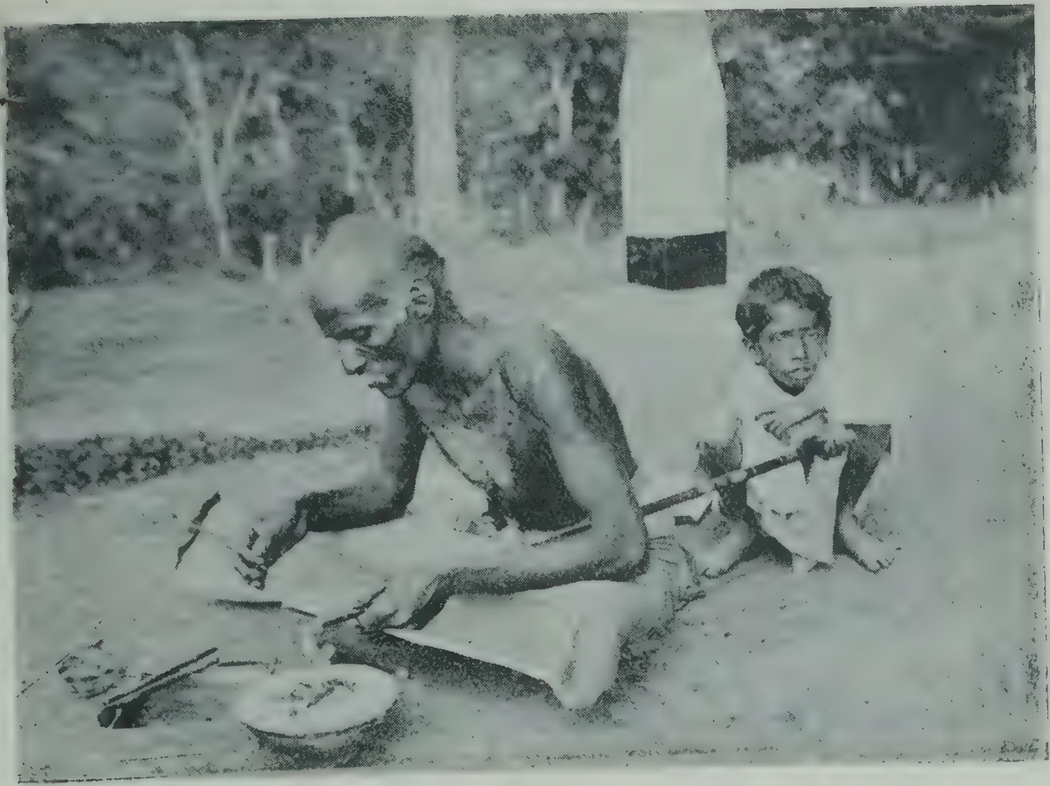
David, D. B. : Pair flower baskets made entirely of cloves

Dambewinne, H. E., Ratemahatmaya, Welimada : Mats.

Dingiri Appu : Bronze door handle.

De Silva, Mrs. W. A. : Sinhalese embroidery.

De Silva, Miss E. : Sinhalese embroidery.



LAC WORKER.

SILVERSMITH.

De Abrew, Miss : Sinhalese embroidery.

De Lanerolle, Rev. A. : Map of Buddhist cosmogony.

Goonesekere, H. A., Ratemahatmaya : Door handle, "patistane," "sesta kot," "sesat" ferrules, key plate, basket, "chamara," "dansala," whip, walking-stick, rope hide, betel bag, specimens of "yakkaha dummala," "galdummala," "hora," wax.

Hin Appu, P. M. : old brassware.

Hin Appu, M. B. : Carved spoon racks.

Hurikaduwe R. Podi Sinno : Honey comb and devil dancer's hat.

Jayawardene, Miss Felicia : Native dyed baskets, mats, &c.

Jayawardene, Miss Mary, J. C. : Native dyed baskets, mats, &c.

Kandy Art Association : Art exhibit of silver, brassware, &c.

Keppitipola, T. B. : Old Sinhalese embroidery.

Lewis Hamy : Silver work.

Moragammane Ran Naide : Sickle handle.

Muhandirama, D. S. : Door handles.

Muhandirama, Disave : Elephant bells.

Muhandirama, Kirihami : Kandyan art drawing.

Mudaliyar of Alutkuru korale : Grass mats.

Mudaliyar of Puttalam pattu : Grass mats.

Mudaliyar A. Naganathar : Jaffna baskets.

Mudaliyar Abeyesekere : Mats of various designs.

Musæus School : Sinhalese embroidery.

Nugawela, C. B. : Old Sinhalese embroidery

Naide, Hapuwide Kiri : Chunam boxes, old sword, &c.

Nillawela Sellappu, Pata Hewaheta : Ebony elephant ornamented with silver.

Pancho Nachchire : Betel bags, cigar cases ("hembili").

Pediris Hami, M. B. : Arecanut cutters, "kendia."

Sellappu, R. M. : Brassware, &c.

Siman Naide, T : Brassware.

Sonandare, K. Brassware, &c.

Vallipuram and Son., Negombo : Brassware.

Welegedara, K. B., Ratemahatmeya : Knives, scythes, &c.

(3) *List of Working Parties.*

Lace Makers of Colombo District : Boralesgamuwe Baba Nona, Boralesgamuwe Punchi Nona, and Boralesgamuwe Gimo Nona.

Jaffna Painter : M. Doresamy.

Lace Workers of Matale : Kiri Naide and Ran Naide.

Silver Workers of Yatinuwara : Kiri Appu Mudiyanse, O. G. Appu, Jenappu, Ran Naide, and Kirihami Muhandirama.

Brass Workers of Udugampola : M. Appu. M. B. Pedris Hami, M. B. Hin Appu, J. Muhandirama.

Silver Workers of Udugampola : P. M. Hin Appu. M. Kirihami. K. M. Kirihami Muhandirama. and Dingiri Appu Muhandirama.

Painters of Harispattu : Kirihami Muhandirama and W. Ran Naide.

Ivory Workers : Disave Muhandirama, Harispattu : B. Ran Naide. Pata Dumbara ; and D. S. Muhandirama. Udunuwara.

Gold and Silver Workers : P. L. Don Naide, Harispattu.

Pottery Painters : M. P. M. Abaran Appu. Pata Dumbara : K. M. Sonandara, Harispattu : and P. Sellappu. Pata Dumbara.

Iron Founders of Udunuwara : Dingiri Appu. Abaran Appu. and Patabenda.

Ivory Turners of Udunuwara : Appu Naide and Kalu Naide.

Potters of Udunuwara : Guttila, Kuda Naide. Ran Naide, and Ebitta.

Iron Damescening Workers of Udunuwara : Hin Appu and Dingiri Appu.

Brass Founders of Yatinuwara : Siman Naide, Kiri Appu, Ran Naide, Abaran Appu, Kuda Naide, and Appu.

Cotton Cloth Weavers of Uda Dumbara : Tikirati, Silpa. Gunaya, and ten others.

Lace Workers of Pata Dumbara : Naide and Mekappu.

Mat Weavers of Pata Dumbara : Lapaya. Puncha. Pina, and Menika.

Dyers of Mannar : P. Antoni Pillai and N. Antoni Pillai.

Brass Workers of Batticaloa : S. Arumokam, E. Tirikumaran, and K. Ponnampalam.

Cloth Weavers of Batticaloa : P. H. Yanamuttu. V. Kadiresan, S. Kanagaratnam. R. Kunchi Tambi. and T. Sinna Tambi.

Basket Weavers of Kalutara : Pancho Nachchire and Nanno Nachchire.

Ivory Turners of Kegalla : Ran Naide of Moragammana and Punchi Naide of Moragammana.

Cloth Weavers from India : Kovil Pillai and Velanayakam.

(4) *Special Exhibits of Agricultural Produce.*

Bamber, M. Kelway : Coconut products. tobacco. distillation of camphor.

Barber. C. C. : Products of the cacao tree and chocolate.

Carolis. W. D : Ceylon dyeing materials.

Ceylon Tea Plantation Co., Ltd.: Coconut products and fibre.

De Soysa, J. W. C. : Samples of cotton from Kurunegala.

Drieberg, C. (Supdt. of School Gardens) : Oils, fibres, and tanning and dyeing stuffs.

Fernando, Dr. H. M. : Samples of cotton from Kurunegala.

Government Experiment Station, Gangaruwa : Cocoa pods (3 varieties), citronella, and lemongrass.

Green, E. E. (Govt. Entomologist) : Silk and silk worms.

Kahawatta Estate : Catch crops—Castor oil seeds, Ceara seed.

Kalutara Totamune Mudaliyar : Catch crops—Groundnuts.

Rajapakse, A. E., Mudaliyar : Cinnamon from Negombo district.

Vavasseur, & Co., J. H. : Coconut products and fibre.

Westland, James : Catch crops—Ayapane tea, cardamoms, vanilla, &c.

Whitehead, Jos. : Cotton ginning and dyeing.

(5) *Exhibit of Native Oils, Gums, Dyes, Tanning Materials, and Fibres.*

Oil Seeds.

Aba—Brassica juncea (Indian mustard).
Batu Endaru—Ricinus communis (castor oil).
Del—Artocarpus nobilis.
Domba—Calophyllum inophyllum.
Ela Endaru—Ricinus communis.
Endaru—Ricinus communis.
Hín Endaru—Ricinus communis.
Iriya—Myristica Iriya.
Kaju—Anacardium occidentale.
Karanda—Pongamia glabra.
Kena—Calophyllum tomentosum.
Kekuna—Aleurites triloba (the oil kekuna).
Kohomba—Azadirachta indica (margosa).
Kon—Schleichera trijuga (Ceylon oak).
Kurundu—Cinnamomum zeylanicum.
Maha Endaru—Ricinus communis.
Mi—Bassia longifolia.
Na—Mesua ferrea.
Palu—Mimusops hexandra.
Ratakaju—Arachis hypogæa (groundnuts).
Rata Endaru—Ricinus communis.
Tala—Sesamum indicum.

Oils.

Endaru—Ricinus communis.
Karanda—Pongamia glabra.
Kina—Calophyllum tomentosum.
Kekuna—Canarium zeylanicum.
Kohomba—Azadirachta indica (margosa).
Kon—Schleichera trijuga.
Mi—Bassia longifolia.
Miriya—Dichopsis grandis.
Mustard—Brassica juncea.
Na—Mesua ferrea.
Polkatu-tel—(creosote from coconut shell).
Tala—Sesamum indicum.
Tolol—Trichadenia zeylanica.

Gums, Resins, and Lac.

Dummala—Resin.
Galdummala—Ground resin.
Gasdummola—Tree resin.
Hal—Vateria acuminata.
Hora—Dipterocarpus zeylanicus.
Kaju—Anacardium occidentale.
Kekuna—Canarium zeylanicum.
Keppettiya—Croton lacciferum.
Yakhalu—Doona trapezifolia.

Dyes.

Bombu—(leaves) Symplocos spicata.
Chaya root—Oldenlandia umbellata.
Guru—Red clay.
Kadol (mangrove)—Rhizophora mucronata.
Kos (leaves)—Artocarpus integrifolia.
Makulu—White clay.
Pandu—Yellow dye generally got from jak (Artocarpus integrifolia).
Patangi (sapan)—Cæsalpinia Sapan.
Polkatu anguru (coconut shell charcoal)
Ratakaha (annatto)—Bixa orellana.
Samara—Yellow clay.
Timbiri (seeds)—Diospyros embryopteris.
Welikaha (leaves)—Memecylon capitellatum.

Tanning Barks, &c.

Aralu—Terminalia Chebula.
Bulu—Terminalia belerica.
Ehela—Cassia fistula.

Kadol (Mangrove)—Rhizophora mucronata.
Kaju (bark)—Anacardium occidentale.
Ranawara—Cassia auriculata.
Wa—Cassia siamea.

Fibres.

Alandu—Allæanthus zeylanicus.
Beli—Hibiscus tiliaceus (twine and fibre).
Cotton—Gossypium var.
Coconut—Cocos nucifera.
Daminiya—Grewia tiliæfolia.
Dul—Anodendron paniculatum.
Hana Sunu—hemp, fibre, twine (Crotalaria juncea).
Kaluwel—Derris scandens.
Kitul—Caryota urens.
Liniya—Helicteres Isora.
Lolu—Cordia myxa.
Mayila—Bauhinia racemosa (fibre from bark).
Muwakiriya-wel—Sarcostemma Brunonianum.
Nawa—Sterculia balanghas.
Niyanda—Sanseviera zeylanica (four kinds dyed).
Palmyrah—Borassus flabellifer.
Puwakgedia wel—Hiptage Madablota.
Puswel—Entada scandens.
Riti—Antiaris innoxia (a suit, &c.).
Ma-we-wel—Calamus rudentum.
Weniwel—Coscinium fenestratum.

Exhibition of Arts and Crafts.

REPORT BY DR. ANANDA K. COOMARASWAMY.

THE Exhibition of Arts and Crafts of Ceylon held under the auspices of the Ceylon Agricultural Society at the Ceylon Rubber Exhibition at Peradeniya proved a great success. A part of it consisted of an exhibit of old work; but of more especial interest were the groups of craftsmen at work; workmen from all parts of the Island were represented, Tamils as well as Sinhalese, and care was taken to ensure the work being carried out according to the original methods and in the best way. The public had therefore an unique opportunity of realizing the character and value of the indigenous crafts of Ceylon. It is a matter for congratulation, moreover, that the Agricultural Society has taken an interest in these crafts, as their existence is now endangered in several ways, especially by the decline in local demand, and the tendency to adopt new and easier methods of work and to imitate an inferior style

of European decoration. It is a strange thing that the people of the country, who should be the first and chief patrons of the indigenous crafts, are actually the last to appreciate them or to give that intelligent sympathy and criticism without which it is doubly hard for the craftsman to maintain the standard of their work, or to keep their work in touch with modern requirements. Does a Kandyan wish for more light and air than the old walawwas afforded, then, instead of explaining his requirements to the traditional architects who have worked for his family in the past, and so modifying the very excellent style of Kandyan architecture to meet modern needs, he at once calls in a low-country builder who has no real knowledge even of the European style (if such a thing can now be said to exist) and no pretence even of a knowledge of the Sinhalese style ; and the result is that a jerry-built building is put up at three or four times the necessary cost, and in the most nondescript and meaningless style imaginable, often, for instance, a far-away echo of Italian Renaissance filtered through the villadom of London suburbs. The furniture and decoration are of the same sort.

Anything tending to raise the local work in the estimation of Ceylonese is to be welcomed, and in the meanwhile steps must be taken to encourage the remaining craftsmen and to preserve their traditional skill, a valuable asset which if once entirely lost to the Colony can never by any process be recovered.

The following is a summary list of the crafts represented at the exhibition :—

Sinhalese.

Achari caste.—Painters, ivory carvers, silver and brass workers, founders, ivory turners, blacksmiths, and lac workers.

Badahelayo.—Potters.
Beruwayo.—Weavers.
Kinnarayo.—Mat weavers.
Lace makers.—Kalutara basket makers.

Tamil.

Painter on mica (Jaffna) ; weavers (Batticaloa) ; brass-founders (Batticaloa) ; weavers (Southern India) ; dyers with chaya root (Mannar).

The principal exhibits of old work were contributed by Mr. T. B. Keppitipola, the Tellijawila Local Agricultural Society, and the present writer.

A great deal of interest was taken by visitors in the work, much of which was unfamiliar. It is apparent that some arrangement by which the buying public can be put in touch with craftsmen in different parts of the Island is much to be desired. The work of the Kandy Art Association is of course excellent, but the productions are rather inaccessible to Colombo people and to passengers, and are drawn only from one district. There are things (such as the Matara cane baskets) made in other districts which would also find purchasers if they were more widely known and easily obtainable. Most of the craftsmen were accommodated in a special octagonal building in the Kandyan style and with a cadjan roof; in the centre was an octagonal table built round the centre post and on which specimens of old work were exhibited. The space next to the outside wall was divided by half partitions into separate booths for the different workmen. Those using fire or requiring to embed their machinery in the ground worked on the bare earth; the remainder of the building had a wooden floor. The space between the central table and the workmen's booths was left free for the passage of visitors.* A stall was occupied by the Kandy Art Association and there was a considerable sale of their work; the craftsmen were also allowed to sell their work, and some were very successful in doing so. The wages paid varied from Rs. 5 to 75 cents per diem, according to the men's skill and position and the distance from which they had come. The selection of workmen was left to the present writer, who was assisted by the Local Agricultural Societies, the Government Agents of the different Provinces, and the Kandy Art Association; these details are mentioned for the convenience of those who may be called upon to organize a similar exhibit on a future occasion.

Amongst the most interesting exhibits of craftsmen may be mentioned the weavers from Uda Dumbara, almost the only survival of a former widespread industry amongst the Sinhalese, and one it is hoped may be revived. Most picturesque were the groups of women spinning and singing at the work. The cloths made have high artistic qualities and are very durable. The intricate methods of the lac workers who decorate sticks, boxes, &c., with elaborate patterns in red, yellow, green, and black lac were new to many. Of blacksmith's work, the process of inlaying silver and brass on iron was well demonstrated by two groups of workers from the Kandy District. The door handles they made were fine specimens of the blacksmith's art. Hinges and box handles are also made by them and

* Weavers and matmakers were accommodated in separate tents.

other fittings. The painters and ivory carvers also did excellent work. In a separate tent the Kinnaras of Dumbara worked at weaving mats, using their very primitive loom.

There were several exhibits sent by Local Agricultural Societies from different parts of the Island, not only of old work, but also some excellent new work, such as Matara cane baskets, Kalutara grass baskets, a fine adze from Kotmale, good hand-woven cloths from Jaffna, specimens of Sinhalese embroidery, and various other things. Mention should be made especially of a fine ivory model of the Dalada Maligawa made by the order of King Kirti Sri, and dedicated by him to the Hittetia temple, near Matara; also an excellent exhibit of various old things belonging to Mr. T. B. Keppitipola, including an interesting embroidered hat (*ispaya*), embroidered bag, &c. The exhibits of examples of modern Sinhalese embroidery were of great interest, in connection with recent efforts to revive the indigenous style with its characteristic patterns and useful stitches.

Mr. Coryton Roberts' Exhibits.

THESE were on view in a special building, and were confined to wood cut into veneer on a process now introduced for the first time into Ceylon. The wood in this form may be joined into composite boarding of various kinds by means of a cement, of which Mr. Roberts himself is the patentee as discoverer. The process is reported to be very rapid.

The plain veneer can be used for a great many purposes without being cemented. It is stated to have been found especially useful for making supply baskets for rubber plants, tea, &c. It is claimed that these baskets are firmer than the ordinary bamboo baskets, and can be delivered in closely packed bales, thereby affecting a great saving in transport. The veneer can be cut into any thickness, from 1–100th part of an inch to a fourth of an inch or more. In the thicker size it is believed to be useful as supports and shading for rubber trees, also for the construction of wooden tea tats. The building in which the proprietor exhibited these veneers was in itself a testimony of the many uses to which the veneer may be put, since it was built almost entirely of veneer, that is, the doors, windows, walls, ceiling, fretwork, and ventilator window shutters were all veneer; the roof, too, was in composite corrugated veneer.

LACE WORKERS.

The Exhibit of Ceylon Woods.

An interesting exhibit of specimens of Ceylon woods was shown at the Ceylon Rubber Exhibition.

These included some fine log specimens, viz., Ebony of 20 in. diameter, Satinwood of 27 in., Mimusops hexandra of 24 in., Mahogany of 24 in., Cassia Siamea of 19 in., and Terminalia glabra of 30 in. There were also some beautiful planks 5 ft. by 15 in. to 24 in. by 2 in. of the same species, with the addition of Berrya Ammonilla and Chickrassia tabularis. The transverse, vertical, and tangential sections of all logs were exposed and polished, and exhibited exquisite shading and colouring. The planks were very effective.

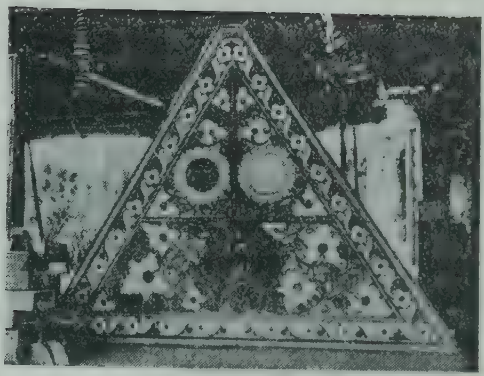
The figury "satinwood" log was conspicuous with its beautiful silver grain and fine satiny lustre, the cause of which is still problematical, but may be due to irregular growth from the cambium, though other reasons are assigned equally credible. The ebony specimens were particularly effective, ranging from deep black to wavy longitudinal streaks tinged red and brown and to a mottled yellow and gray. These varieties may be attributable to cross fertilization. The deep red of the Mimusops hexandra, the splendid shading of deep and light brown with the reddish tinge of the Terminalia glabra, the satiny appearance of the Chickrassia tabularis, and the beautifully mottled and shaded Cassia siamea all attracted much attention. The mahogany specimen was a rich one, grown in Jaffna from imported seed. The absence of that rare wood Calamander was deplorable, but no specimens are obtainable, and the tree is almost extinct. The Wild Jak (Artocarpus integrifolia) and Nedun (Pericopsis Mooniana) are very scarce, having been so largely indented on for furniture.

Separately arranged in a frame work of satin and ebony were 320 specimens about 9 in. by 6 in. by $1\frac{1}{2}$ in., representing 160 species and 41 orders. Of the specimens, the North-Western Province contributed 117, the Western Province 28, the Central Province 66, Uva 24, the Eastern Province 43, the Northern Province 29, and the Southern Province 13. In duplicate there were 27 specimens, in triplicate 7, and of the Diospyros ebenum there were 5. Where duplicated, either in an individual Province or in more than one, there are pronounced differences, which can only be attributed to climatic and soil variations.

A small pamphlet accompanied the specimens, and contains a very brief record of the uses of the various timbers. The gregarious forest which is found so frequently in India is not represented here, though the Na (Mesua ferrea), Hora (Dipterocarpus zeylanicus), and the Halmilla (Berrya Ammonilla) have

tendencies in that direction. Nor are Ceylon trees of equal magnitude with those in India. The best of the satinwood and ebony has been depleted for the home market. There have been extensive alienations for the higher forms of cultivation and forirrigation purposes, and the system of shifting cultivation is rampant, so that the forests have much to contend against.

The distribution of trees and the characteristics attached to such distribution are not referred to in this short note as space is limited, but there is valuable information on the subject in Mr. Vincent's report of 1883 and in Mr. Broun's description to be found in Dr. Trimen's "Handbook of the Flora of Ceylon," Vol. V. In that work and in Gamble's "Manual of Indian Timbers" botanical and wood descriptions and the economic uses of trees and plants are to be found.



A CEILING CLOTH.

APPENDIX A.

CIRCULAR LETTER REGARDING THE RUBBER EXHIBITION.

Royal Botanic Gardens,
Peradeniya, Ceylon,
February, 1906.

GENTLEMEN,—I AM desired by the Committee to inform you that a *Rubber Exhibition* under authority of the Ceylon Government will be held in the Royal Botanic Gardens, Peradeniya, Ceylon, from the 13th to the 27th September, 1906, and to invite you to contribute. This will be the first exhibition of its kind ever held, and should mark an epoch in the history of rubber.

2. You are probably aware, from seeing the market quotations and from reading the technical papers, that rubber is now being cultivated in Ceylon and the Federated Malay States, and though the exports as yet are inconsiderable, they are doubling annually, and will, in about seven years' time, probably reach ten or fifteen million pounds and increase rapidly after that, in fifteen years from now probably exceeding the exports of Brazil.

3. Plantation rubber is cleaner and purer, and is at present selling at 7*d.* to 10*d.* a pound more than fine Para. It is important that manufacturers should as early as may be inform themselves as to *plantation rubber from the East*, the modes of preparation, the cost of production, possibilities,

and disadvantages, for the future lies with it, and wild rubbers will be driven off the market, excepting perhaps the Para rubber of Brazil, for which there is likely to be some use and a remunerative price for a long while yet.

4. Hitherto, owing to the small supply of cultivated rubber upon the market, two things have happened. Manufacturers have not made any special machinery to deal with it, but have mixed it with the dirty wild rubbers they have been in the habit of using, and planters have not adopted any special form in which to send it to market, but having started with the singularly inconvenient form of biscuits have gone on with these, though it is evident that they are absolutely unsuited to preparation on the larger scale which the expanding trade requires. To deal with the latter first, the planter must adopt some less cumbrous and expensive mode of preparation. The manufacturers in England have objected to lace and crepe on the ground that these are a form of scrap, and that adulteration will be easy. The well-established reputation of the Ceylon Planter in the preparation of tea and cacao and other products hardly renders this last apprehension deserving of serious consideration.

5. To see the different processes adopted in the East and to assist in the development of the best methods for the preparation of rubber is to the interest of the manufacturers.

6. Manufacturers have not as yet made any special machinery nor any alterations in machinery to enable them to deal with the clean dry product sent from Ceylon and the Federated Malay States. The present cumbersome methods of cleaning and otherwise preparing the rubber do not commend themselves as likely to endure. It would appear desirable that preparation of the rubber and its manufacture should go hand in hand, and the rubber be prepared in different ways to suit different kinds of manufacture. A beginning in this direction will form a special feature of the Show; samples of rubber coloured, mixed, and vulcanised by new processes invented by Mr. Kelway Bamber, Chemist and Analyst to the Ceylon Government, will be exhibited.

7. The exhibition will comprise anything and everything that has to do with rubber, and you are particularly invited to exhibit anything of your own manufacture, whether only in the finished state or in various stages of preparation, any forms of machinery, and anything else likely to prove of interest. Power will be provided.

8. The exhibition will be open for a fortnight. It will be held at the most central and familiar place in Ceylon, and should attract all rubber planters from the East and dealers from India, the Federated Malay States, and other countries.

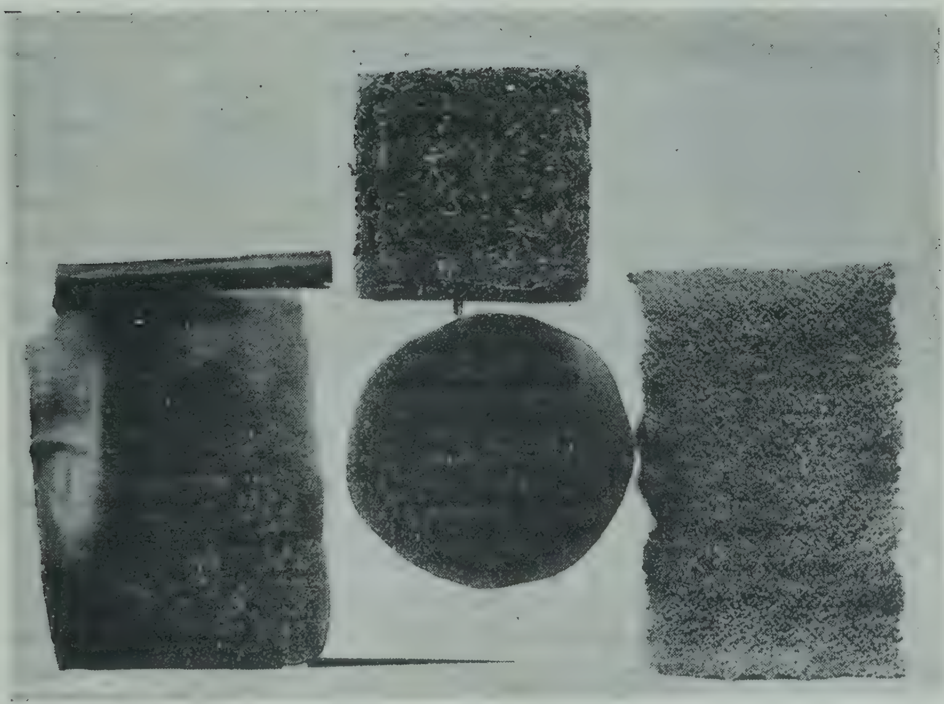
It will consequently offer you an unrivalled opportunity for getting into touch with the producers, and perhaps for making contracts for supply of rubber prepared to suit your own requirements.

9. No import duty will be charged upon articles entered for exhibition, and free railway carriage will be given from Colombo on all exhibits. Entries must be addressed to E. B. Denham, Esq., C.C.S., the Secretariat, Colombo—to reach him before July 31, and goods should be forwarded from Europe not later than that date.

I am, &c.,

JOHN C. WILLIS,

Director, Royal Botanic Gardens,
Peradeniya, Ceylon.



SAMPLES OF RUBBER.

1 *Sheet*
2 *Scrap*
3 *Biscuit*
4 *Crepe*

APPENDIX B.

DINNER TO THE JUDGES AND DELEGATES.

THE dinner to the Exhibition Judges and Delegates in the Queen's Hotel, Kandy, was a felicitous and successful gathering. His Excellency Sir Henry Blake, President of the Exhibition Committee, presided, and was supported on the right by Mr. Carruthers, Hon. Mr. E. Rosling, Dr. Willis, Mr. Zacharias, Mr. C. Devitt, and Mr. James Ryan; and on the left by the Hon. Messrs. J. P. Lewis, G. M. Fowler, and Francis Beven, Mr. J. R. Martin, Mr. W. D. Gibbon, &c. There were about sixty present altogether, and the croupiers were Messrs. Cameron (Bangalore), Edgar Turner, Denham, and Dawson.

The Toast List.

HIS EXCELLENCY THE GOVERNOR proposed the toast of the health of HIS MAJESTY THE KING which was loyally drunk, the Band playing the National Anthem.

HEALTH OF "THE JUDGES."

HIS EXCELLENCY THE GOVERNOR, in proposing the health of the Judges, said :—The toast of the judges that I am about to propose for your acceptance is one that will commend itself to everybody who is interested in the Rubber Exhibition, or who realises what the result may be of the Exhibition now being held for all those who have invested their capital in the rubber industry. (Applause.) One of the first questions that came before the Committee was the question of judging, and after consideration it was thought well that the judges should, if possible, be got from outside the area of rubber cultivation. In pursuance of that determination application was made and invitation was issued to London for rubber experts who would be in a position to judge, having regard to the standard

of the market and to the market requirements of rubber as prepared; and in these young athletes (applause)—who came in answer to our invitation you will have observed for the past week, with great care and thoroughness testing the hundred of samples of rubber in the Exhibition—you see the result; and I think it is proof of the wisdom of the conclusion come to by the Committee. (Applause.) Some of the older planters, gentlemen, remarked on the youth of the judges. (Laughter.) They thought they were rather young for judges of rubber; but I venture to say to these elderly gentlemen did not know what judging rubber meant. I think if they entered into a tug of war with their neighbours' biscuits for a day or two, they might possibly find their muscles required that youthful resiliency. (Laughter.) Two things are necessary for judging rubber, as far as I can see. You want the expert, and you require the knowledge of the expert, and you require the strength of an athlete; and as for the one, we must remember when we consider our young friends—for they are our young friends—that our youth are the heirs of experience; that they have had at their command all the filtered and concentrated knowledge of all ages. (Applause.) In the first place they knew the knowledge was there. As to the second point, well, the mangled remains of biscuits, sheets, and biscuits, I think, bear testimony that to the strong all things are possible. (Laughter and applause.) But I think we are all agreed that the judging of this rubber by these gentlemen has been well and thoroughly done, and they will carry back with them the thanks of all those connected with the Exhibition and the full confidence that their decisions may very properly be accepted. Now, gentlemen, in other directions there are also other branches of the exhibits—that is, the portion of the exhibits of the different tools for the extraction of latex—which I believe have just been judged, and I believe judged with as much thoroughness as that of the rubber. Those who have done this duty have personally tested every instrument in the Exhibition; and I am given to understand that when the awards are made, it will be found that in this, as in other branches of mechanical sciences, simplicity is the key-note of the highest excellence. (Applause.) The machinery has not yet been judged. There is an immense amount of interest in it, and I believe the judgment of the machinery will take place to-morrow morning. Now, gentlemen, what is, so far as we see the result of this Exhibition. Well, in the first place, I think that Ceylon has proved it can produce rubber as good as that of its closest neighbours. (Applause.) Next, I think, that the Exhibition has shown that rubber can be satisfactorily grown at least to the elevation of

3,000 ft. These are very important factors in our future prosperity. (Applause.) Then, again, we have learned from the excellent samples placed before us from the Malay States, that the days of the biscuit rubber are numbered. I have seen the biscuits prepared in much the same way as a Scotch or Irish house-wife prepared a girdle cake in the good old-fashioned way, with a heavy bottle doing duty for a roller. All that is past, and those excellent exhibits sent by the Malay States show that if we are to take our proper place in the market in the future we must fight shy of the bottle. (Laughter and applause.) I believe that the result of the Exhibition, gentlemen, has satisfied all those who have ventured their money in this new industry, and the probabilities of the successful investment are as great as they are in regard to any product of which we know. We have not alone profited from the Exhibition itself, but I think the interesting lectures and discussions that have taken place have covered almost the entire ground, and have shown everything that is known with reference to the rubber from the seed to the macintosh and all the vast possibilities of the new directions in which rubber may and will be used in the future ; and I think that with that knowledge, and especially with the additional knowledge we have derived from that excellent exhibit of Mr. Kelway Bamber's (cheers), which has given an indication of the possibilities in the future of the establishment of an additional industry in Ceylon that will make the rubber brokers in London shake in their shoes. (Laughter.) I think all these matters are quite sufficient to show us that there is not so much danger of over-production, and I think that it is sufficient to minimise that fear of over-production that invariably follows the first fury of investment. (Cheers.) It is very curious what numbers of uses rubber can be put to and how long rubber has been known. I was looking up an encyclopædia a day or two ago on the subject of rubber, and I found that almost in the second voyage of Columbus, about the year 1500, even in Hayti they played a game with a ball made from the gum of a tree, and Cercorado said that rubber was then used in Mexico for the purpose of rubber oil (laughter) which was used in Mexico for the purpose of removing tightness of the chest. (Loud laughter.) Well now, gentlemen, 300 years later we might find it will remove tightness of the money chest. (Laughter.) It is also stated that it was drunk with cocoa for the purpose of preventing hemorrhage. (Laughter.) But for the most singular use of rubber we must go to an older book and to an earlier date. Looking over the book of Ramayana which you, gentlemen, resident in Ceylon, may know was written 2,000 or 3,000 years ago—the great Indian

epic—we have mention of Rama going for fourteen years' austerity into the woods, in which time he was clothed in the bark of a tree and matted his hair with the juice of the banyan tree, which is the first instance in which rubber latex has been mentioned, and then it was used as a hairwash. (Laughter.) This takes me away from my subject. Gentlemen, I present to you the toast of the Judges, who have, as I say, earned our admiration for the thoroughness with which they have done the work that has been placed before them and gained the confidence of every exhibitor by the awards that they have made. I ask you, gentlemen, to join with me in drinking the health of the Judges and wishing them in the future every prosperity. (Cheers.)

The toast was drunk with enthusiasm.

Mr. S. BRETT replying said :—I beg to express my deep sense of gratitude in the name of my colleagues and myself for the reception which has been given to this toast. We all feel very gratified by the tribute which Your Excellency has paid to the work we have been able to do in coming out here. (Hear, hear.) I feel quite convinced that no one can fully appreciate the meaning of the word hospitality who has not been to Ceylon in the capacity of a Rubber Judge. (Laughter.) Our respective firms have sent us out here on the invitation of your Committee, as they felt quite sure we should have many opportunities of coming into contact with planters, and in that way gaining a great deal of useful information which, after the discharge of our duties out here, would enable us to return better qualified to look after the interest of planters at home. (Cheers.) I do not think that in sending us out, our firms realised quite how useful our mission has proved in the information that we have already gained about the rubber industry in Ceylon. (Hear, Hear.) Your Excellency referred to our youth. (Laughter.) The Ceylon rubber industry is also young. (Laughter.) But in spite of the fact that it has only existed on a commercial scale for a few years, it is extremely satisfactory to find that, during almost the whole of the period, it has fetched a price on the markets of Europe which is in excess of that of finest Para previously known (Cheers.) That, gentlemen, is a satisfactory start, and with all your natural and scientific advantages it will be most surprising if the future is not still brighter. (Cheers.) I know that the information you are anxious for is as to the requirements of the manufacturers. Of course, what they chiefly value in rubber is strength, elasticity, and durability, and I think that once you have proved that your product contains these qualities in an equal degree to the standard South American Para, trade will be won for you. (Cheers.) And,

although one is inclined to be rather optimistic perhaps, in the presence of all this enthusiasm, I have always found that Ceylon rubber and Malaya rubber have up to the present been experimented with only on a small scale; one cannot hurry it, for the manufacturing at home must have time to go into the thing very carefully and perfect their methods of preparing and manufacturing the imported rubber. In the case of other rubber it has always been a matter of considerable time before the various mixings and compoundings in the factory have been perfected, and it is only natural this should also be so with Eastern plantation rubber. And since we arrived in Ceylon, I am sure I am speaking for all the Judges in saying that our impression of Ceylon and Malaya rubber is decidedly hopeful, and we have all been very much struck with the many qualities that the exhibits possess. (Hear, hear.) In fact, judging entirely in a physical way, it looks as if some of your samples possess all the qualities of the Para—(Hear, hear,)—and I do not know whether I am not going too far in saying that they possess some of the main characteristics in a greater degree than Para possesses them. If I am right in this, it seems to me it must only be a question of time and your being able to place large quantities on the market, before the intrinsic value of your product is fully realised by the manufacturer at home. (Cheers.) I have heard now and then certain opinions that this Exhibition might prove premature: but as far as we are concerned anyhow, and I think most of us in this room will agree, that this idea is wholly and absolutely exploded. I do not think there can be any doubt that the lessons that have already been learned in this exhibition, which is still in an early stage, are of the greatest importance, and we do not yet realise how far-reaching they may be (Hear, hear.) So I think that those who were responsible for the creation and organisation of the Ceylon Rubber Exhibition are most heartily to be congratulated on the great success they have achieved. (Cheers.) Lastly, gentlemen, I think you ought also to congratulate all those extremely energetic and capable gentlemen who have interested themselves in the Exhibition and spent their efforts, hand in hand with the planters, for the ultimate benefit of the Rubber Industry. (Cheers.)

"THE FOREIGN REPRESENTATIVES" PROPOSED BY MR. J. R. MARTIN.

MR. J. R. MARTIN:—Your Excellency and gentlemen, I rise to propose the Health of the Foreign Representatives—amongst whom I might be permitted to include our fellow-planters from Southern India and the Federated Malay

States. I am sure we thank them for very kindly coming so far to see our Show and encourage us with their presence and advice, and on behalf of the Planters of Ceylon I offer them a hearty welcome. (Applause.) One of the most interesting features of the Exhibition—certainly the leading feature—is the magnificent show of rubber sent by the Federated Malay States; and if Ceylon has come out rather on the top in the award of prizes, I hope that merely will be a matter of emulation for the future and for future shows of which, perhaps this is only the forerunner. Not only the Federated Malay States, but India will send better exhibits to compete with us and try to lower our colours which we have won at this Exhibition. (Applause.) This friendly rivalry between British planters must lead to the road of perfection; and it is to perfection I think you must look if you are to retain the position you have already attained. We must show the buyers of London, the manufacturers, and the British Public, and the public of the world, in fact, that the best rubber—and therefore, the cheapest rubber in the long run—is the rubber produced by the British planters of the East. The chief lessons, I think, Sir, of this Exhibition have been found in the advantage of the interchange of ideas between planters and the interchange has been well exemplified by the lectures which you have attended and honoured by your presence, and at which you have done your best to foster the discussions raised (applause); and I think, Sir, speaking on that subject, I can congratulate you on the success of this Exhibition you have taken so much trouble to organise. (Applause.) Speaking at the opening of the Exhibition, you mentioned (and with perfect justice) some officials and some unofficial gentlemen who have done a great deal towards attaining success and putting up the buildings in the remarkably short time they have done. Your officials included some Civil Servants, and there were two gentlemen, who, through some delicacy, Your Excellency did not—but whom I, as a planter, would like to mention. Two gentlemen who worked in a way which commanded the planters' admiration. The way they had taken off their coats, if I may say so, and done the work of the Exhibition with untiring energy and unvarying courtesy won our admiration; and those gentlemen, I think I may say, are Mr. Denham and Mr. Galbraith. (Loud applause.) I trust, Sir, as I have said before, that this is only the first of a series of friendly competitions, and that we shall have the opportunity again of welcoming our friends and competitors from other British Colonies and India, and whenever they come to Ceylon I can promise them a most hearty welcome from Planters of Ceylon, and I now drink their health. (Applause.)

Mr. Carruthers in reply.

Mr. Carruthers—who was enthusiastically received—in reply said :—Your Excellency and gentlemen, I find myself in the rather difficult position of having to consider myself a visitor and a stranger in Ceylon, but I will do my best to act the part for the nonce. Some clever student of human nature, and chiefly British human nature, once said that he could tell an Englishman, an Irishman, or a Scotchman by the way they got out of a train. (Laughter.) The Irishman jumped out almost before the train had stopped ; the Englishman, after due deliberation, gathered up his parcels and opened the carriage door after the train had stopped ; and the Scotsman waited in the far corner to see if there were any parcels left in the carriage by those who had stepped out. (Laughter.) I am a Scotsman—(renewed laughter)—and I find myself in the position, after Your Excellency's speech and the speeches of Mr. Brett and Mr. Martin, of trying to gather up any parcels left in the carriage. I do not think I am exaggerating in saying that this Exhibition, originated by Your Excellency, and which Your Excellency's Committee so well organised, is an epoch-marking Show. Mr. Brett referred to the fact that the youth of the Judges might be palliated by the fact that rubber is very young. I think we may consider ourselves at this Show as being present at the christening of an extremely healthy young babe, and I hope this child will grow and wax strong until he will threaten the existence of the veteran of Brazil ; and I hope most of us will live to see a sturdy fight between the Brazilian veteran and our bantling here. (Applause.) The mother of all Exhibitions, I think, Sir, as far as Britishers are concerned, was the great Exhibition of 1851, which the Prince Consort started, and, I think, we are, perhaps, now present at a time when the Mother of Rubber Exhibitions is being started by yourself, and will inevitably be followed by a crop of Exhibitions such as has continuously followed the great 1851 Exhibition. And some days ago I took the liberty of proposing to Your Excellency that this Exhibition should not stop here in Ceylon where it is. We fully realise the importance in more ways than I can put before you by telling you of the great importance of this Exhibition to the practical planter and judges : and, although the judges are modest, I believe they have learned as much from us as we have learned from them. Therefore, we should consider that this should be one of a series of Exhibitions. I am not in a position, owing to the minor official position which I hold in the Federated Malay States, ("Oh") to say but I have every confidence that His Excellency Sir Wm. Taylor, the Resident-General, who was formerly in Ceylon,

and all other officials who would have a voice in this matter would allow me to say, if I could have obtained their opinion, that they would be glad if the second Exhibition after a short space of time—perhaps after three years—should take place in the Federated Malay States, which is at present the only other country growing a large area of rubber except Ceylon, or even in another six years, for I imagine that it would take more than that to get up such a splendid Exhibition as you have treated us to during last week. I hope I am in order at present in suggesting that this should not be allowed to be a splendid Exhibition standing by itself, but the forerunner of a series of exhibitions which may go on when we go home to shoot grouse and drink port, with the large sums of money we have made from the rubber tree, so that those who follow us may gain such knowledge, as we have gained from this, from future exhibitions. (Hear, hear.) We cannot, of course, in holding an Exhibition in the Federated Malay States give you the beautiful Kandyan setting to the Exhibition which has added so much to the charm of this Exhibition. That is not possible. I do not think any visitor can realise how much we can gain by the beautiful setting of these Botanical Gardens and also by the beautiful exhibition buildings which Mr. Dunuwille and his assistants have put up, as well as by the costumes of the native ladies and others who have attended these functions. Anybody who attended the jolly little gymkhana on Saturday, which was a sort of a rest from the judging and study of the Exhibition, could not fail to have been struck by the extreme picturesqueness of the whole scene. We cannot expect to set our Exhibition so prettily as this among Kandyan surroundings, but perhaps the Malayan Sultans and their suites may interest themselves in it, and they also have their picturesqueness of garb and appearance which we all hope you will come to see and you will find them beautiful. (Hear, hear.) Mr. Martin referred to the fact that nearly all the gold medals have gone to Ceylon. I am perfectly sure, and I feel sure, all other gentlemen who are associated with me as visitors to the Exhibition and the gentlemen who have exhibited rubber will agree, that we are all perfectly satisfied with the way the Judges did their work, and are satisfied that the prizes went to the exhibitors of the best rubber in the separate classes. At the same time there is a silver lining to our clouds ; and if you have won the rubber, I cannot help thinking that we have the biggest score below the line, and we have got proof that we have in the block rubber from Johore, rubber which undoubtedly shows a step in the right direction in preparation and export. (Hear, hear.) I must not close without, as Mr. Brett has done, referring to the

extreme pleasure we have all had in accepting the cordial hospitality you have extended to us, as I said before I find myself in a difficult position as a stranger in Ceylon. No one loves Ceylon more than I do, and no one was more sorry to leave Ceylon than I was; but I cannot help feeling that the knowledge we have all earned here has been beyond what we expected. We were perfectly satisfied, as we sailed to Ceylon, that we would be treated in a kindly and hospitable manner, and I think all visitors will agree that we have been treated as a Scotsman would say "with the hicht of hospitality." As I mentioned the Prince Consort as the father of exhibitions, I think you, Sir, like your royal master, have done a great deal towards a cordial relationship between rubber-growing countries, and if we have series of exhibitions in which we shall fight, as Mr. Martin said, to get top prizes, I feel quite certain, whatever happens, if the Exhibition is managed as this Exhibition has been, we shall entertain the most cordial feelings towards each other. (Cheers.)

Mr. P. W. Parkinson :—Your Excellency and gentlemen, the previous speakers left very little for me to say and have entirely taken the wind out of my sails. We must thank you for the kind way you have drunk our health. We have seen the Exhibition, and we find it most interesting and instructive, and I am quite sure that the lessons learned from it must be of great value to planters who have seen the Show. The industry is a young one, and in all young industries we have a tremendous amount to learn, and exhibitions such as the one we have seen are the great things to help us, where we see tapping, curing, and the latex machinery connected with rubber. Shows of this kind are of the greatest importance in helping us to bring our industry to a successful issue. We have seen numerous samples shown from Ceylon and the Federated Malay States, and Ceylon in fair competition holds the palm except in the one point of the best rubber in the Show. (Applause.) There is nothing like healthy competition, and it must be remembered that in competing with us in the Federated Malay States, it is to a great extent a case of ex-Ceylon competing with present Ceylon, and the capital invested in the Federated Malay States is largely Ceylon capital. I hope in the future this competition will go on, and that the rivalry will be a healthy one between Southern India, Ceylon, and the Malay States. I should like to thank you for the extremely kind manner in which you have entertained us. More has been done for us than we could possibly expect, and I thank you on behalf of myself and my brother delegates for all you have done for us. When any of you come to the Malay States we shall try to return your hospitality. Gentlemen,

in the names of the planters of the Federated Malay States. I thank you. (Applause.)

THE CHAIRMAN'S HEALTH PROPOSED BY MR. LEWIS.

The Hon. Mr. J. P. LEWIS, in proposing the health of the Chairman, said :— May it please Your Excellency, gentlemen, the duty which has fallen to my lot on this occasion is a pleasant one. I have no doubt it would be an easy one to my colleagues on the Committee, most of whom are more accustomed to making speeches than I have been myself. I have been suddenly transported from the wilds of Marichchukkade to the groves of Peradeniya, and from the Pearl Fishery Kottu to the Exhibition Buildings, from the contemplation of the rusting remains of Dixon's machinery to the spectacle of Brown & Davidson's Model Macerator at work. (Laughter and applause.) I have been removed from contact with the speculating pearl merchants of the fishery to the society of robber—I mean rubber—kings—(laughter) who never speculate. (Renewed laughter.) I have exchanged the Company of Marine Biologists for that of Rubber Experts, and I must say that the change has been a pleasant one. (Laughter.) I have ceased to take an interest in Pearl Oysters and substituted for it Rubber Biscuits. (Laughter.) I believe the name of Ryan is derived from the word for king. (Laughter.) If I am wrong in my etymology—if it is not—then all I can say is that it ought to be. (Laughter.) Gentlemen, I think the Rubber Exhibition has been a success. There were plenty of exhibits both as to quantity and as to quality, and Ceylon has no reason to be ashamed of the part it has taken in furthering the rubber industry. The Exhibition has been a success also from an educational point of view. I now know what are "earthy niggers." (Laughter.) I have learned how to pronounce the words "Para" and "Ceara." I have even heaved a sigh when I read the name *Hevea brasilensis* in the papers not knowing how to pronounce it and having no one to tell me how. It may have been a *heavier* task than I anticipated, how to pronounce the word. (Laughter.) We have been informed by His Excellency himself that the Rubber Committee woke up just in time. If that had not been the case we should already have the exhibits without any building to exhibit them in. What we wanted was not merely a building to stow our rubber in but also to exhibit them. In fact if we had gone on as we started to do, we might have had a building impossible to distinguish from the cooly lines on the Northern Railway. It might be argued in defence of the Committee that they knew how long to prolong their somnolence, having ascertained to a nicety how long it would take

to provide the buildings. They were started at a psychological moment as well as at the lucky hour. (Laughter.) Our indefatigable Secretary had a similar experience. He was also transported from the North, and although I may say I myself felt like a fish out of water—perhaps I should say an oyster out of water—(Laughter)—it was not the same with the Honorary Secretary who merely returned to his native element. (Laughter.) With regard to the buildings I think as far as the plan goes we are indebted to Mr. Turner and Mr. Galbraith, and for the ornateness of the building and for the adoption of the Kandyan style, which proves so highly successful, we are entirely indebted to His Excellency Sir Henry Blake. (Applause.)

His Excellency the Governor replies.

His Excellency the Governor :—Gentlemen, I thank you very much for having drunk my health so heartily. I should like to say a few words with reference to the Exhibition and about the question of which Mr. Lewis has told you. I will mention a few facts as regards the Exhibition, because it was stated that possibly it might have been better if we had advertised a little sooner and more extensively, and for the purpose of showing you that that is rather a mistake. I may tell you how it came about from the beginning. I think it was in February that Mr. Ryan first laid before me the idea of having a Rubber Exhibition. (Cheers.) I then appointed a Committee in February, containing the then Government Agent here and the gentlemen at Peradeniya, and in that month circulars were sent to 157 firms. Further in March the Secretary of State and the Imperial Institute were addressed and asked to advertise, and the consulates of Ceylon received particulars and they were sent to every country where rubber is being grown. From many press cutting agencies poured in their references, and Reuter's Agency circulated the advertisements all over the world, so that I think you will see that the advertising of the Exhibition was taken in hand very early by the Committee, and I think it was very thoroughly done, and I may tell you that the first exhibit sent in was made by a German house. (Hear, hear.) Now, gentlemen, we have said a great deal about rubber up to the present, and I have no doubt that, as far as rubber is concerned, the effect of the Exhibition will be far-reaching and unquestionably beneficial in the highest degree not alone to Ceylon, but also to the Federated Malay States and to our friends across the water in India. (Hear, hear.) One word more with reference to rubber, and a short one, and that is with regard to the fear of synthetic

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rubber coming in and interfering with tapped rubber in the market. We have seen pictures of men carrying their tyres made of wheat as a substitute for rubber. Since we have sat down I have received the following telegram [which he read]. Proceeding he said :—We had assumed that, even before we received this telegram ; but there is another aspect of the Exhibition I have not spoken of, and which is well worthy of attention, and I think it is a most interesting portion of the Exhibition. As you know, the Exhibition was built by Kandyan villagers and beautifully built, showing that in their building and their art the Kandyans have preserved their old artistic feeling throughout these centuries. But there is also an interesting branch of the Exhibition, and that is the specimens of native arts and crafts that have been brought together —weaving, brass work, iron work, lace-making, &c. I do not think there is anything more pathetic than the disappearance of native industries—the village industries,—that afford life and happiness to the people and make them feel at the end of their days' work they have created something. They were creators and saw that it was good. They have been submerged by the Moloch of the 19th century machines, but I hope we shall be able to revive the industries that carry happiness to the villagers in the country, and I think a most interesting portion of the Exhibition is made by those which survive at the present moment, and are now being carried on in the hope that we may be able to induce a larger number of people to adopt weaving and painting, &c., in the future, so that these industries may survive. (Cheers.) I think, gentlemen, that the Committee has worked extremely well. It is all very well to say that nothing was done when there was no opportunity of knowing exactly what we wanted. Nobody knew exactly where we were. The Committee had invited people to send in exhibits. They had sent circulars all round the world and had not received answers, and they were actually in the position of not knowing what they were to provide for, and even at the moment when they undertook to put their shoulders to the wheel and produce something that they would be certain to have in time as far as pace was concerned, they were really ignorant as to what was required. The whole thing was a shot, and a very good shot it has turned out to be. (Hear, hear.) There is just enough room for what has been sent in and none to spare. I was glad to see the way you received Mr. Martin's remarks on the members of the Committee and the Secretary, Mr. Denham. It was a great pleasure to see the Exhibition turn out as it has, and I am sure it will be very successful indeed, and I am sure it will continue to receive the heartiest co-operation of all the inhabitants of this district.

This completed the official toast list, but Mr. Carruthers could not refrain from asking to be allowed to drink to His Excellency and the other hosts. He wished long life and prosperity to their rubber industry.

The toast was drunk and the gathering dispersed.

Besides the official dinner to the Judges and Foreign Delegates, there were several social functions during the Exhibition which were most successful. Their Excellencies the Governor and Lady Blake gave a garden party at the King's Pavilion in Kandy, and on another day the Ceylon Planters' Association were "at home" in the Royal Botanic Gardens. The Ceylon Mounted Rifles also held a gymkhana in the Gardens near the Exhibition. The last official function was the distribution of the gold and silver medals and cups to successful exhibitors. This was graciously done by Her Excellency Lady Blake, who had throughout taken much interest in the Exhibition, in the Central Hall of the Exhibition buildings.

A CEILING CLOTH.

APPENDIX C.

THE USE AND OBJECTS OF AGRICULTURAL SOCIETIES.

Paper read by Mr. E. B. DENHAM, C.C.S., before the Meeting of the Board of Agriculture at the Royal Botanic Gardens, on September 17, 1906.

THE Agricultural Society was founded by His Excellency the Governor in November, 1904. It has to-day 1,120 members and 45 branches, with a membership of approximately 3,500. The progress report tabled to-day shows the number of interests and industries the Society deals with, while if further proof of its activity is required members can see for themselves the different exhibits sent in by local branches and members of the Society to the Rubber Exhibition.

The usefulness of the Society has been, I venture to think, abundantly demonstrated by the success of the many Agricultural Shows held this year and last, and by the keen interest displayed in all agricultural subjects.

His Excellency's well-known desire to encourage and promote all branches of Agriculture has been the principal cause of the increased interest in the subject which has now shown itself in the formation of branches, in the holding of Shows, in agricultural discussion and debates. Agriculture has been in the air, and agriculture has been well advertised. It has been advertised in the vernacular as well as in English.

The Native Press have played a very considerable part in assisting the Society to explain its objects to the "goiya" in his own language. The "Dinakaraprakasa" and the

"Sihala Samaya"—two of the leading Sinhalese newspapers—record fully in Sinhalese the proceedings of the Board and the papers read before it The Editors of these papers send 100 or 200 free copies of the issues containing these proceedings to the Secretary of the Ceylon Agricultural Society for distribution, and these are sent to the local branches.

All the leaflets of the Society appear in Sinhalese and Tamil as well as in English; the "Tropical Agriculturist and Magazine of the Ceylon Agricultural Society" has a Sinhalese edition "The Govikam Sangarawa," edited by Mr. C. Drieberg, an officer of much experience in all agricultural matters: and a Tamil edition, "The Kamat Tholil Velakkum," published by the Jaffna "Morning Star."

The proceedings of many of the branches are conducted in the vernaculars. It is important to emphasize this point, for the Society's utility depends on its being able to reach those who, from their ignorance of the English language, are unable to get their information first hand from Peradeniya. To Peradeniya all agriculturists must look for improved knowledge for the results of the careful study of science, for the data for all experiments, and on no one more than the Director of the Botanic Gardens and his staff must the Society depend for success. The Society is intended to be the interpreter of the Botanical Supreme Court. The Chief Justice, the Director, has arraigned before him a hapless goiya accused by science, represented by Mr. Kelway Bamber with a Sumatran tobacco plant, or Mr. Petch with a bud rotted coconut palm. He is charged with gross neglect of all scientific methods of cultivation and with pursuing the methods of the "iron age." His excuse murmured in Sinhalese is ignorance. The Judge orders a Peradeniya Circular to be administered. Excellent as is the remedy, the case of the villager reminds one of the English labourer, who, according to "Punch," begged of the physician that the pills might not be packed in such solid boxes, as he found them difficult to swallow. With all the wealth of knowledge that this Island is so fortunate as to possess at Peradeniya, any agency for disseminating that knowledge must be useful, and such an agency the Agricultural Society endeavours to supply with the help of its local branches.

The Society has now as its magazine the "Tropical Agriculturist and Magazine of the Ceylon Agricultural Society," edited by Dr. Willis, with a reputation second to none among the agricultural journals of the East. Every member of the Society gets the magazine free.

I have touched only on the literary side of the Society's efforts, not because I consider them the most important, but because they are the only side which presents itself to the

large majority of the general public. The work done by the local Societies can only be realized at first hand; it can only be accurately estimated by personal inspection. By the *work* done by its members the Society must stand or fall. Many of its branches are, I fear, little more than debating societies, where "village Catos give their little Senates laws, and sit attentive to their own applause." But even these, if they allow of the exchange of ideas and the records of experiment, may be of some use—that they are deserving of more praise I am not prepared to say. But practical work has been done—vegetables have been planted out, experimental gardens opened, and demonstrations in castration of cattle held.

In several places *working members'* branches have been started—the first of these was in the Kuruwiti korale, where 32 villagers joined, 22 of whom gave a donation to the branch, in addition to undertaking an experiment. Rs. 11·25 was paid in subscriptions by villagers. These branches have as their rule of membership that a subscription is voluntary, but that every member must, as a condition of membership, undertake to carry out an agricultural "experiment"—*e.g.*, either open a plot of ground with vegetables, plant chillies in his garden, transplant the paddy in his field, or try seed paddy from another district. It need not be a new experiment, but it must mean doing a piece of work connected with agriculture.

Another useful means of improving agriculture has been the distribution of manures, supplied free by Messrs. Freudenberg & Co., to members whose names are sent in by the local branches. By this means a series of useful experiments are being made all over the Island, which will afford most valuable data, and at the same time introduce the principles of manuring in places where manures have hitherto not been used.

Village Shows have been inagurated by the Society; a most successful one was held at Minuwangoda, a report on which by Mr. C. Drieberg has appeared in the Society's magazine. These Shows are held on market days at important village centres, and the prizes are subscribed for by members of the local societies. Judges are appointed, who go round the different booths and stalls and make their awards. In to-day's report mention is made of one of these Shows, which was arranged for at a meeting held at Ruanwella. The Market Show will be held at the Yatiyantota Market, and, as will be seen from the Progress Report, twenty-six prizes (nine of Rs. 10 and seventeen of Rs. 5) have been subscribed for by members of the branch. All the prizes are to be given for well-known native vegetables and cultivations—the object being to improve and increase the varieties.

In a paper like this it is only possible to touch on a very few of the subjects with which the Society is endeavouring to deal. Members who have perused the Progress Reports published monthly will have noted the efforts of the Society to establish new varieties of paddy from India and Japan—the introduction of new products, such as date palm suckers, new varieties of yams from the West Indies, the encouragement of cotton cultivation in chenas, and distribution of vegetable seeds ; the efforts to establish a sericulture industry, and the work done in castration of cattle, by the Government Veterinary Surgeon and his staff—particulars of which can be obtained from paragraphs 16 and 17 of to-day's Progress Report. All these subjects have had the attention and encouragement of His Excellency and the members of the Board. The use of the branch societies as co-operative centres, both for experiments and for the adoption of the co-operative credit system, is another side of the Society's work.

The usefulness of the Society justifies its existence, the success of its objects would alone justify its extinction. The objects of no Society can be achieved until that Society is rendered unnecessary. The usefulness of the Society, the worthiness of its objects, none may dispute ; but, however useful the machine may be, however sound the objects for which it is intended, it can never prove its use and succeed in its objects until it is worked under the best conditions and proved to be generally and practically useful. As is asked of every invention, How long will this principle be admitted ? Will it not be pronounced obsolete or even absurd in a few years' time ? So it is with this Society. We must ask ourselves, How far its elements are transitory ? What are its sources of strength and of weakness ? Is its permanence assured ? The Society is a voluntary one ; many of its members are no doubt attracted by the knowledge that its President, His Excellency the Governor, takes the greatest interest in its working, and encourages its efforts ; others by the fact that they receive an excellent magazine at a very low cost. But it is not on any individual members or any class of members that the Society depends for a continued course of usefulness. This must depend on the local societies and the work done by them. No amount of Board meetings, of discussions, of leaflets or magazines can save the Society, if it is not in touch with the local cultivator. How can the Society keep in touch with the great mass of the population of Ceylon ? Only by making itself heard in a language that they can understand.

The Society, as I have said before, is intended to be the agricultural interpreter for the Island—it must have many interpreters working under it. These interpreters must go

out into the highways and byways and preach improved systems of agriculture. Just as the school gardens are intended to be centres of agricultural demonstrations, to teach villagers how to lay out a garden and what to plant in it, so should the Agricultural Instructors be men who are able to explain the systems the gardens demonstrate. It is on its Agricultural Instructors that the success of the Society as a popular exponent of agricultural truths must depend. No information can be more usefully imparted than by practical demonstration. The Agricultural Instructors must then be men who will take their coats off and show the villager how to carry out experiments. It is not so necessary that they should be disciples of any particular school of foreign thought on the subject of tuberculosis in plants, as that they should have learnt to use their eyes and their hands. They should be at first rather Agricultural Inspectors than Instructors, reporters of facts rather than repeaters of platitudes. If these men would only collect and report on any specimens of disease caused by fungus or insect, I am sure that they would prove most useful assistants to Mr. Green and Mr. Petch, as well as render great benefit to the country. It is most important that the right stamp of men should be obtained for these posts ; they must be capable both of working themselves and making others work, possessed of influence as well as taking an interest in their work. I need not say more as to their requirements, for it is on *their* Instructors that we must depend for securing and training the right stamp of men. It will not be one of the least benefits that Peradeniya has bestowed on Ceylon, if the Director of the Royal Botanic Gardens and his staff can train young men, who will be imbued with a spirit of enthusiasm for their work, and who will be anxious to do their utmost in the interests of the different cultivations of the Island.

The Agricultural Society and its branches should further offer a wide field for the collection of agricultural information ; all experiments and their results should be carefully collected, reports of unusual yields, of diseases, of unexpected failures, should all be recorded. Analyses should be made of soils, which called for special study on account of the results obtained from them. Detailed information should be procurable by every planter of the crops grown, the results, reasons, average rainfall, &c., of every district in which there is a branch of the Agricultural Society. The excellent work now being done by the Land Settlement Department could be most usefully supplemented by the work of the Agricultural Society. Selection of lands and of crops would be greatly assisted by a Department with full and carefully prepared records.

When we see what has been done through branches of the Agricultural Society in the collection of beautiful articles to illustrate the arts and crafts of different districts at this Exhibition (the Rubber Exhibition), we see no reason why equally successful attempts should not be made to procure detailed and useful statistics of different cultivations.

To cite only one instance where there is a great need for such detailed information—the North-Central Province. The experiments now being made at Maha Iluppalama in rubber cultivation under irrigation, in cotton, in Indian grains, and vegetables can all be most usefully supplemented by the work of local societies in the North-Central Province. A guide to the Crown land in the North-Central, North-Western, and Northern Provinces, giving details of crops grown, analyses of soil, &c., might prove of great assistance in solving the problem of the development of the route through which the Northern Railway runs. Again, a staff of Agricultural Inspectors or Instructors working through the villages should obtain most useful information for those thinking of purchasing land.

The importance of obtaining information relative to the different soils, situation, &c., of land is of course well recognized in India, as on its careful compilation depends the successful collection of the land tax. The lines of work I have endeavoured to sketch are, it may be said, rather those of a Department than of a voluntary society. Can the Agricultural Society, as at present constituted, undertake this work, or is it first necessary that it should be made into a Department? In its beginning the Society was necessarily a voluntary one, an experiment, which has, I venture to think, been fully justified. If it is to expand on the lines which such a Society should naturally take, and, which I have ventured to sketch very roughly, it must, I think, be worked by a Department. What form that Department should take it is outside the subject of this paper to attempt to sketch. In some parts of India we find Departments of Agriculture and Land Records, in others Departments of Agriculture and Commerce, in others Departments of Arts and Crafts.

It may be asked whether, after all, Agricultural Societies are necessary, if there is to be a Department of Agriculture? My answer to this question would be "yes." Agricultural Societies are local councils, which enable the people to meet together under their recognized leaders for discussion and exchange of ideas. The principles of societies and associations are thoroughly well understood in this country. They are natural agencies for the exchange of ideas, and they allow the natural leaders of the people to take their proper place in them by their energies and control them.

The Agricultural Society can be productive of nothing but good, whatever its final stage may be. Under the direction of His Excellency the Governor, with whose name it will always be associated, we can have no doubt of its utility and the practical value of its objects.

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Special Notice to the Rubber Planting World.

PARA, CASTILLOA, CEARA, &c.

Seeds and Stumps forwarded to all parts of the World.

Telegraphic Orders.—*From a leading Planter, Java, March*, 1906: "Book 500,000 Para seed for August-September shipment: send 25,000 stumps soon; credit advice sent forward." Again he writes, 4th June, 1906: "Yours of the 23rd to hand. We are very glad to have received the 25,000 Hevea stumps in very best condition beginning of May: many thanks. We shall do a good business together in future."

From an Agricultural Department, Washington, U.S.A., 28th March, 1906: "Book 250,000 Hevea seed for August-September; shipment to Honolulu."

From a Mercantile Firm, Batavia, 7th April, 1906: On ascertaining price by wire for 500,000 Hevea seed, wired back "Offer accepted."

From an Import and Export Merchant, Sydney, 6th August, 1906, "I now beg to confirm my order of 150,000 Hevea seeds at £——— per 1,000, which includes freight paid to Sydney and guaranteed 75 per cent. good arrival at destination in the Solomon Islands."

A leading Planter writes from Samoa touching a shipment of 100,000 Para stumps, 16th March, 1906: "The stumps have arrived, and although it is too early to say how many are good, I feel sure that the extra stumps you packed will cover your guarantee." Again he writes, 11th June, 1906: "I am glad to inform you the progress of the plants is very satisfactory, and a little later I hope to send you approximately the number of good plants in the nursery."

A Colombo Firm in ordering a further supply of Hevea seed for Uganda writes to our Agent, Mr. E. B. Creasy, at Colombo, 26th February, 1906: "We have been informed that Hevea seeds forwarded from Messrs. William & Bros. have turned out very good, one lot showing 100 per cent. germinated seed."

The Secretary of a large Rubber Corporation in ordering a supply of Hevea seeds for Liberia, writes, London, 3rd September, 1906: "I am strongly recommended by the authorities at ———, who are interesting themselves in the experiments, to obtain a consignment of Hevea seed from Ceylon. They have kindly furnished me with your name and address as Merchants of Hevea seed who can be thoroughly trusted."

Seeds and Plants of Numerous Commercial Products Supplied, including Tea, Celebrated Arabian Liberian Hybrid Coffee, Cocoa, Kola, Sisal, and other Fibres, &c.

Descriptive Catalogues with Circulars and Special Offers post free to Foreign Countries. Separate Price List for Ceylon.

"SOUTH AFRICA," the great authority on South African affairs, of 25th March, 1899, says:—

"An interesting Catalogue reaches us from the East. It is issued by WILLIAM BROTHERS, Tropical Seed Merchants of Henaratgoda, Ceylon, and schedules all the useful and beautiful plants which will thrive in tropical and semi-tropical regions. We fancy Messrs. Williams should do good business, for now that the great Powers have grabbed all the waste places of the earth, they must turn to and prove that they were worth the grabbing. We recommend the great Powers and Concessionaries under them to go to William Brothers"

Agents in London:—Messrs. P. W. WOOLLEY & Co., 90, Lower Thames Street.

Agent in Colombo, Ceylon:—E. B. CREASY, ESQ.

Telegraphic Address:
WILLIAM. HENARATGODA, CEYLON.
Liber's, A.I. and A.B.C. Codes used.
Also Private Codes.

J. P. WILLIAM & BROTHERS,
Tropical Seed Merchants.
HENARATGODA, CEYLON.

Awarded Gold, Silver, Commemoration, and other Medals, Diplomas, Merits, and Certificates at various International Exhibitions, including St. Louis, 1904.

Awarded Bronze Medal with Diploma for our Para and Castilloa Rubbers at St. Louis Exhibition, 1904.